User's Manual
Landfill Air Emissions Estimation Model

Windows Version 1.0
DOS Version 2.0

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PREFACE

The Control Technology Center was established by the U.S. Environmental Protection Agency's (EPA's) Office of Research and Development (ORD) to provide technical assistance to state and local air pollution agencies. Several levels of assistance can be provided when appropriate. These include the following:

- **CTC HOTLINE** provides quick access to EPA expertise, information, and assistance on matters relating to control technology (919/541-0800).

- **Engineering Assistance Projects** provide more in-depth assistance to state and local agencies when needed to address a specific pollution problem or source.

- **Technical Guidance Projects** address problems or source categories of regional or national interest by developing technical guidance documents, computer software, or presentation of workshops on control technology issues.

- **Federal Small Business Assistance Program (SBAF)** coordinates efforts among EPA centers participating in the Federal Small Business Assistance Program to assist state SBAPs.

- **International Technical Information Center for Global Greenhouse Gases** provides information on global greenhouse gas emissions and available prevention, mitigation, and control technologies and strategies.

- **RACT/BACT/LAER Clearinghouse (RBLC)** bulletin board system (BBS) provides access to more than 3100 pollution prevention (P2) and control technology determinations addressing over 200 pollutants. Select the RBLC from the technical BBS menu on the OAQPS Technology Transfer Center (TTN) BBS (919/541-5742).

- **CTC BBS** on the OAQPS TTN provides around-the-clock access to all CTC services, including downloadable copies of many CTC products. Select CTC from the TTN BBS Technical BBS menu (919/541-5742).

- **CTC NEWS** is a quarterly newsletter published by the CTC. It contains updates on all CTC activities including the RBLC and Federal SBAP. Call or write the CTC to get on the CTC NEWS mailing list.

ABSTRACT

This document is a user's guide for a computer model, the Landfill Air Emissions Estimation Model, for estimating air pollutant emissions from municipal solid waste (MSW) landfills. The model was developed by the Control Technology Center. This manual provides step-by-step guidance for using this model. The Landfill Air Emissions Estimation Model can be used to estimate emission rates for methane, carbon dioxide, nonmethane organic compounds, and individual toxic air pollutants from landfills. The program can also be used by landfill owners and operators to determine if a landfill is subject to the control requirements of the federal New Source Performance Standard (NSPS) for new MSW landfills (40 CFR 60 subpart WWW) or the emission guidelines for existing MSW landfills (40 CFR 60 Subpart Cc).

The model is based on a first order decay equation. The model can be run using site-specific data for the parameters needed to estimate emissions or, if no site-specific data are available, using default values. There are two sets of default values. One set is based on the requirements of the NSPS and emission guidelines. This set of default values produces conservative emission estimates and can be used to determine whether the landfill is subject to the control requirements of the NSPS and emission guidelines. The other set of default values is based on emission factors in the U.S. Environmental Protection Agency's (EPA's) compilation of emission factors, AP-42. This set of default values produces more representative emission values and can be used to produce typical emission estimates in the absence of site-specific test data. The default values presently in the model may be revised in future updates of the model based on new information collected by the EPA.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

LIST OF TABLES

GLOSSARY OF TERMS

Term	Definition
Codisposal	Disposal of hazardous waste as well as other kinds of waste in a landfill.
Landfill Capacity	The total amount of refuse that can be disposed of in the landfill.
Landfill Gas	Landfill gas is a product of biodegradation of refuse in landfills and consists of primarily methane and carbon dioxide, with trace amounts of NMOC and toxic air pollutants.
Methane Generation Rate Constant (k)	k is a constant that determines the rate of landfill gas generation. The first-order decomposition model assumes that k values before and after peak landfill gas generation are the same. k is a function of moisture content in the landfill refuse, availability of nutrients for methanogens, pH, and temperature.
Nonmethane Organic Compounds (NMOC)	NMOC are specified in this program as the fraction of landfill gas containing nonmethane organic compounds, expressed as hexane. NMOC include toxic air pollutants and volatile organic compounds. NMOC concentration can be measured using guidance provided by the proposed EPA Method 25C.
Potential Methane Generation Capacity (Lo)	Lo is a constant that represents the potential capacity of a landfill to generate methane (a primary constituent of landfill gas). Lo depends on the amount of cellulose in the refuse.
Toxic Air Pollutants	Compounds found in landfill gas or emitted with landfill gas that are listed as toxic air pollutants under section 112 of the Clean Air Act. A total of 46 toxic air pollutants emitted from landfills are regulated.
Closure Year	The year in which the landfill ceases, or is expected to cease, accepting waste.

1.0 INTRODUCTION

The Landfill Air Emissions Estimation Model provides an automated estimation tool for quantifying air emissions from municipal solid waste (MSW) landfills. This manual provides an introduction to the model and step-by-step instructions for using it. The model was developed by the Control Technology Center (CTC) of the U.S. Environmental Protection Agency and can be obtained by downloading from the CTC bulletin board.

Air emissions from landfills come from landfill gas, generated by the decomposition of refuse in the landfill. Landfill gas is assumed by this model to be roughly half methane and half carbon dioxide, with additional, relatively low concentrations of other air pollutants. The following information is needed to estimate emissions from a landfill (See the Glossary of Terms):

- The design capacity of the landfill,
- The amount of refuse in place in the landfill, or the annual refuse acceptance rate for the landfill,
- The methane generation rate (k),
- The potential methane generation capacity (Lo),
- The concentration of nonmethane organic compounds (NMOC) found in the landfill gas,
- The concentrations of toxic air pollutants found in the landfill gas,
- The years the landfill has been in operation, and
- Whether the landfill has been used for disposal of hazardous waste (codisposal).

The estimation method used by the model is a simple first-order decay equation. Because the data available for landfills, such as data on the quantity, age, and composition of the

refuse in the landfill, are limited, using a more sophisticated calculation method was not justified. The Landfill Air Emissions Estimation Model estimates emissions of methane, carbon dioxide, nonmethane organic compounds, and toxic air pollutants. Information on the assumptions used in the model can be found in the background information document (NTIS-PB91-197061) written to support the Standards of Performance for New Stationary Sources (40 CFR 60 Subpart WWW) and Guidelines for Control of Existing Sources (40 CFR 60 Subpart Cc) and in the public docket (Docket A-88-09).

The Landfill Air Emissions Estimation Model is regarded as a screening tool. Often it is not until a gas extraction system is placed in a landfill that the quantity of landfill gas produced can be accurately determined. Landfill gas production test data may be needed to determine the quantity of gas emitted from a particular landfill.

The Landfill Air Emissions Estimation Model can be used with site-specific data for all the information needed to generate emission estimates, or it can be used with two different sets of default values. One set of default values (the CAA defaults) is for estimating emissions to determine the applicability of the Clean Air Act (CAA) regulations for MSW landfill emissions, specifically the New Source Performance Standards (NSPS) for new MSW Landfills and the emission guidelines for existing MSW landfills. The NSPS and emission guidelines were proposed May 30, 1991 (56 FR 24468), and the final rule is scheduled to be promulgated in 1995. The applicability of the NSPS or emission guidelines to a particular landfill can be determined based on emissions estimated using the CAA defaults in the model. The applicability of the NSPS and emission guidelines to a particular landfill is determined in tiers. There is, first, a size cutoff (i.e., 2.5 million tons of waste), below which landfills are not subject to the rule. After the size cutoff, the first tier of the applicability determination is to assess whether emissions of NMOC exceed a cutoff value of 50 Mg of NMOC/yr, using the Landfill Air Emission Estimation Model with all default values set for the CAA defaults. Landfills with emissions exceeding the cutoff value can choose to install emission controls or move to the second tier of the applicability determination, which is to test the landfill for landfill gas NMOC concentrations. If the revised

NMOC concentrations result in NMOC emissions that still exceed the cutoff value, the landfill can choose to install emission controls or move to the third tier of the applicability determination, which is to perform another test to obtain a site-specific k value (the methane generation rate constant).

The CAA default values in the model provide emission estimates that would reflect the expected maximum emissions and generally would be used only for determining the applicability of the regulations to a landfill. To estimate actual emissions in the absence of site-specific data, a second set of default values (the AP-42 defaults) is provided in the model. The AP-42 default values in the model are based on emission factors from the U.S. Environmental Protection Agency's compilation of emission factors, AP-42 (EPA, 1995). The AP-42 default values provide emission estimates that should reflect typical landfill emissions and are the values suggested for use in developing estimates for state inventories.

The EPA fully recognizes that modeling landfill air emissions accurately is difficult due to limitations in available information for inputs to the model. However, as new landfills are constructed and operated and better information is collected, the present modeling approach can be improved. As better data become available, including longer term data on landfill air emissions, better modeling approaches are expected to evolve. For example, several firms in the landfill gas industry have models for estimating landfill emissions that are regarded as proprietary. If this information is released to the public, the EPA can use it to improve the present emission estimation approach. In addition, as data become available through the implementation of the NSPS and emission guidelines, the new data can be used to improve the modeling calculations. Questions and comments concerning the landfill model should be directed to Susan Thorneloe of EPA's Air Pollution Prevention and Control Division at 919/541-2709 or by E-Mail at Thorneloe.Susan@epamail.epa.gov.

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1.1 Landfill Emissions

The Landfill Air Emissions Estimation Model estimates the emissions resulting from the biodegradation of refuse in landfills. The anaerobic decomposition of refuse in solid waste landfills causes emissions of landfill gas. As landfill gas passes through the refuse, it sweeps nonmethane organic compounds (NMOC) and toxic air pollutants present in the refuse to the surface. The composition of MSW landfill emissions is estimated by the model to be about 50 percent methane (CH_4) and 50 percent carbon dioxide ($C0_2$), with additional, relatively low concentrations of NMOC and toxic air pollutants. The pollutant regulated under the NSPS and emission guidelines is MSW landfill emissions, but the surrogate for measuring MSW landfill emissions for the applicability of and compliance with the regulations is NMOC.

The EPA has determined that emissions from MSW landfills cause, or contribute significantly to, air pollution that may reasonably be anticipated to endanger public health or welfare. Some NMOC are known or suspected carcinogens, or cause other noncancer health effects. Public welfare concerns include the odor nuisance from the landfill gas and the potential for methane migration, both on-site and off-site, which may lead to explosions or fires. The methane emitted from landfills is also a concern because it is a greenhouse gas and contributes to global climate change. It has been estimated that the United States contributed 8 to 16 teragrams per year (Tg/yr) of methane to the atmosphere in 1990, or about 40 percent of the worldwide amount of methane emitted from landfills and open dumps (Thorneloe et al., 1994). The environmental and welfare concerns associated with MSW landfill air emissions are documented in the preamble to the proposed NSPS and emission guidelines (EPA, 1991a).

This computer model uses a first-order decomposition rate equation and estimates annual emissions over any time period specified by the user. Total landfill gas emissions are estimated by estimating methane generation and doubling it (the landfill gas is assumed to be half methane and half carbon dioxide). Methane generation is estimated using two parameters: Lo, the potential methane generation capacity of the refuse, and k, the methane generation rate

constant, which accounts for how quickly the methane generation rate decreases once it reaches its peak rate. The methane generation rate is assumed to be at its peak upon closure of the landfill or final placement of waste at the site. The model allows the user to enter Lo and k values derived using site-specific test data collected at the landfill (site-specific data may be collected using the test methods specified in the NSPS and emission guidelines for MSW landfills), or to use the CAA or AP-42 default values.

The model estimates emission rates for methane (CH_4), carbon dioxide (CO_2), NMOC, and a list of toxic air pollutants expected to be emitted from landfills based on test data from the U.S. Environmental Protection Agency's (EPA's) compilation of air pollutant emission factors, AP-42 (EPA, 1995).

1.1.1 Methane and CO_2

The NSPS and emission guidelines require only NMOC emission estimates, but the model provides estimates of all constituents of landfill gas. Landfill gas is assumed to be half methane and half CO_2. The model assumes that CO_2 emissions are the same as methane emissions and landfill gas emissions are twice the methane emissions. The generation of methane from a landfill is a function of two values: k, the methane generation rate constant and Lo, the methane generation potential.

The methane generation rate constant, k, determines the rate of generation of methane for each submass of refuse in the landfill. The higher the value of k, the faster the methane generation rate increases and then decays over time. The value of k is a function of the following factors: (1) refuse moisture content, (2) availability of the nutrients for methanogens, (3) pH, and (4) temperature. The k values obtained from the data collected for the NSPS and emission guidelines range from 0.003 to 0.21 (EPA, 1991b). These values were obtained from theoretical models using field test data and from actual field test measurements. If no user-specified k value is entered into the Landfill Air Emission Estimation Model, default values

are used for k. Two default k values are used by the program: 0.05 1/yr for the CAA default option and 0.04 1/yr for the AP-42 default option.

The value for the potential methane generation capacity of refuse (Lo) depends only on the type of refuse present in the landfill. The higher the cellulose content of the refuse, the higher the value of Lo. The values of theoretical and obtainable Lo range from 220 to 9540 ft^3 CH_4/Mg refuse (EPA, 1991a). If no user-specified Lo value is entered into the Landfill Air Emission Estimation Model, default values are used for Lo. The default values of Lo used in the model are 6000 ft^3 CH_4/Mg of refuse for the CAA default option and 4411 ft^3 CH_4/Mg of refuse for the AP-42 default option. The method for deriving these values is outlined in a memorandum in Public Docket A-88-09 (Pelt, 1993).

1.1.2 Toxic Air Pollutants

Landfill gas contains low concentrations of toxic air pollutants, from the leaching and decomposition of waste. The Landfill Air Emissions Estimation Model can estimate emissions of toxic air pollutants if the user chooses to do so. Emissions of toxic air pollutants are based on concentrations of toxic air pollutants in the landfill gas. The model contains default concentrations for specific toxic air pollutant compounds or the user can specify concentrations based on actual site-specific test data, if they are available. The list of toxic air pollutants expected to be emitted with landfill gas and the concentrations of toxic air pollutants present that are used as default values in the model come from test data from 49 test reports in AP-42 (EPA, 1995). Because some toxic air pollutant concentrations in the landfill gas are slightly higher for landfills that have been used for disposal of hazardous waste than for those that have not, there is a choice in the model between "codisposal," that is, landfills used for disposal of hazardous waste, and "no codisposal," that is, landfills that have not been used for disposal of hazardous waste. This choice will affect only the model's estimates for toxic air pollutant emissions. Concentrations in the model for benzene and toluene are different for landfills with hazardous waste "codisposal" than for landfills with "no codisposal."

Landfill sites that have hazardous waste codisposal or Superfund sites should use the codisposal option for estimating toxic air pollutant emissions. Users of the model who do not know whether a landfill has ever been used for hazardous waste should use the codisposal option. However, it is recommended that landfill owners and operators obtain actual test data for toxic air pollutant concentrations in the landfill gas for their specific landfill.

1.1.3 NMOC

The NMOC concentration in the landfill gas is a function of the types of refuse in the landfill and the extent of the reactions that produce various compounds from the anaerobic decomposition of refuse. To determine NMOC concentrations, NMOC data were collected from emission test reports from industry and state and local regulatory agencies (Pelt, 1993). The NMOC concentrations from 23 landfills ranged from 240 to 14,300 ppmv. Three suggested default NMOC concentrations are used in the model: one for the CAA default option and two for the AP42 default option--one for codisposal and one for no codisposal. If the system is using CAA defaults, the default NMOC concentrations as hexane is 4000 ppmv; if the system is using AP-42 defaults, the default NMOC concentration as hexane for codisposal is 2420 ppmv, and for no codisposal is 595 ppmv. The analysis of NMOC concentrations in landfill gas is documented in a memorandum (Pelt, 1993), which can be found in Public Docket No. A-88-09 and in AP-42 (EPA, 1995). Because the NMOC concentration in landfill gas varies from landfill to landfill, collection of site-specific data using proposed EPA Method 25C will provide the most accurate estimates (EPA, 1991a).

1.2 The Model

The Landfill Air Emissions Estimation Model comes in two formats, one for a Windows platform and one for a DOS platform. The program is set up to model and store multiple landfill studies. Within a landfill study, reports and graphs of the estimated emissions can be produced for any particular air pollutant. The model provides the following features:

- Emission rate estimates for methane, NMOC, and toxic air pollutants emitted from solid waste landfills, annually over the life of the landfill and for a specified number of years after the landfill has closed;

- Two different sets of model default values for calculating emissions: a set of default values for determining the applicability of the NSPS or emission guidelines (the CAA defaults) for MSW landfills and a set of default values based on emission factors from AP-42 (the AP-42 defaults).

- Estimates for the year of closure for a landfill based on the landfill capacity and refuse acceptance rate;

- Reports of emissions by pollutant over the life of the landfill for a given landfill, which can be printed; and

- Graphs of emissions by pollutant over the life of the landfill for a given landfill, which can be viewed on the screen in the DOS version of the model and can be viewed and printed in the Windows version of the model.

A typical user session for estimating emissions from a landfill would consist of five steps. This manual discusses the functions of the program under these five steps:

- Opening a landfill study (section 4.1);

- Defining the operating parameters of the landfill (section 4.2);

- Selecting parameters for calculating emissions (section 4.3);

- Reporting emissions (section 4.4); and

- Saving the landfill study (section 4.5).

1.3 New in this Version

The landfill program was originally written as a DOS application. With this version, the DOS model has been upgraded and a new Windows model produced. The original DOS model has been upgraded to include the following:

- The AP-42 default option has been added. The original model had only the CAA (Regulatory) default option.

- The option to select hazardous waste codisposal or no codisposal has been added.

The Windows model has the following additional features that are not available in the DOS version:

- A conversion utility for converting from English units to metric units has been added. The model and the NSPS and emission guidelines use metric units.

- A utility for estimating refuse in place from landfill dimensions has been added for a user who does not have an initial measured amount of refuse in place.

- Data for refuse in place in a landfill can be entered as either refuse in place or as an annual refuse acceptance rate. The program will automatically add the refuse accepted to the current refuse in place to produce a refuse in place value that can be used in the emission calculations.

- The functions of Windows are available, so that multiple landfill studies or multiple reports within a landfill study could be open at one time. For example, two landfill studies could be done simultaneously, using different defaults to compare the emission results.

- Additional HAP data can be entered.

- The file name has been added to the printout.

2.0 OPERATING THE PROGRAMS (Windows and Dos Versions)

2.1 What You Need

An IBM-compatible 386 personal computer is recommended for this program with at least one floppy disk drive and 4 megabytes of memory. The Windows version requires Windows 3.1 or better. A mouse is recommended. The DOS version requires DOS 2.0 or better.

2.2 Installation

Before installing or using the program, make a backup copy of the program (LANDFILL.EXE or LANDWIN.EXE) and, for the DOS version, a backup copy of the data files (AIRTOXIC.TXT, MSHERC.COM, LANDFILL.HLP, and LANDFILL.CFG). Store this backup copy in a safe place for use if something happens to the working copy of the program.

The program may be run either from a floppy disk or from a hard disk. However, hard disk installation is recommended, as information can be accessed more quickly. To run the program from a floppy drive, insert a working copy of the program diskette into the disk drive whenever the program is to be run.

Copy all files on the installation disk to a directory on your system you want to be your working directory. For example, you can make a directory on the c: drive called LANDFILL and make that the working directory.

To make a directory:

At the C:\> prompt, type MD \ LANDFILL

To copy the files from the program diskette to that directory:

1. To change directories to the C:\LANDFILL directory, type CD LANDFILL

2. At the C:\LANDFILL> prompt, type COPY A:*.*

The program may be activated from any directory on the system by specifying the full path (in this case c:\LANDFILL\LANDFILL) or by adding the landfill directory to the system search path (Path = <search path>). Unless you use the program often, it is unnecessary to add it to the system search path. To add the landfill directory to the system search path, at the DOS prompt, type "EDIT C:\AUTOEXEC.BAT" to start the MS-DOS text editor and load AUTOEXEC.BAT. The elements of the path command in the AUTOEXEC.BAT file are separated by semicolons, so to add the landfill directory (C:\LANDFILL) to the path command, move the cursor to the end of the command and type a semicolon and the path to the landfill directory:

;C:\LANDFILL.

The path command line should look something like this:

path C:\DOS; C:\UTIL; C:\; C:\LANDFILL.

Adding the landfill directory to the path command line in the AUTOEXEC.BAT file means that the system will always search that directory for program files.

2.3 Starting the Program

To start the Windows program:

1. In the Program Manager in Windows, open the File Manager.

2. In the File Manager, open the directory in which the LANDWIN.EXE file was placed when you installed the program. For example, if you placed the program in C:\LANDFILL, open the C:\LANDFILL directory.

3. Run the LANDWIN.EXE file by double clicking on it or selecting it, then selecting Run in the File menu.

To start the DOS program:

1. At the DOS prompt, type LANDFILL.

2. For users with HERCULES GRAPHICS CARDS (HGCs), the graphics driver MSHERC.COM must be loaded prior to running the program. Failure to do so will prohibit users with HGCs from displaying graphical information.

3. To load the MSHERC driver, type "MSHERC" at the DOS prompt and press [ENTER]. The message "HERCULES RESIDENT VIDEO SUPPORT ROUTINE. Version 1.11" should appear. The MSHERC driver software is a terminate and stay resident (TSR) application and need not be loaded again as long as DOS continues to run. However, attempting to load MSHERC again is harmless and will result in the message "HERCULES VIDEO SUPPORT ROUTINES are already installed." If at any time the system requires rebooting or power is interrupted, the MSHERC driver must be reloaded.

4. If a hard copy of graphical information is needed, the user must activate the DOS graphics utility GRAPHIC.COM prior to running the program. This will allow the user to print any graphical information from the screen to a printer by simply pressing the print screen key ([ALT][PRINT SCRN]). To load the GRAPHICS utility, type "GRAPHICS" at the DOS prompt and press [ENTER].

5. To activate the program, type LANDFILL at the DOS prompt. If you are not in the disk directory (C:\LANDFILL) in which the model resides and the system search path (set by the PATH = command) does not contain the directory in which the program resides, enter the entire path to the program (e.g., C:\LANDFILL\LANDFILL) to activate the program.

To run the DOS program from the a: drive:

1. Change to the A: drive.

2. Type A:\ [ENTER].

3. Type CD A:\DOS [ENTER].

4. Type LANDFILL [ENTER].

2.4 Stopping the Program

To stop the Windows program:

Double click on the close button in the upper left hand corner of the application window or choose Exit in the File menu.

To stop the DOS program:

Choose Exit from the Main menu. To exit from any sub-menu, press [ESC].

3.0 OPERATING IN THE WINDOWS ENVIRONMENT

3.1 How Windows Work

In this program, you view a document or work on it in a window. There are three types of documents in the landfills program: a landfill study document that contains the operating parameters of a particular landfill and the selections for system defaults, a report of emissions, and a graph of emissions. The reports and graphs are tied to the current active landfill study document.

The major elements of the application window are the menu bar, the mouse pointer, sizing buttons, a close button, and document windows. Within a document window, there will also be a title bar, a mouse pointer, sizing buttons, scrolling bars, and a close button. The landfill study document window has, in addition, a data entry box at the top of the window (Figure 1). This data entry box is for entering data into the landfill study.

- **Menu Bar**. A bar across the top of the window that displays the names of the application menus for the landfill model.
- **Mouse Pointer**. An arrow that indicates the location of the mouse on the screen.
- **Sizing Buttons**. Buttons in the upper right corner of the application window for reducing the window to an icon or restoring the window to full size.
- **Scrolling Bars**. A button in a bar to the right or across the bottom of the window for scrolling through the document contents within a window.
- **Close Button**. A button in the upper left corner of the application window for closing the document or program.
- **Document Windows**. Windows that open within the application window, for displaying and working on documents. Each landfill study, report, or graph is displayed in a separate document window.

- **Data Entry Box**. A box at the top of the landfill study document window, which is used for defining the attributes of and typing text into a landfill study table. As you type data into the data entry box, the data appear and changes are reflected in the landfill study table.

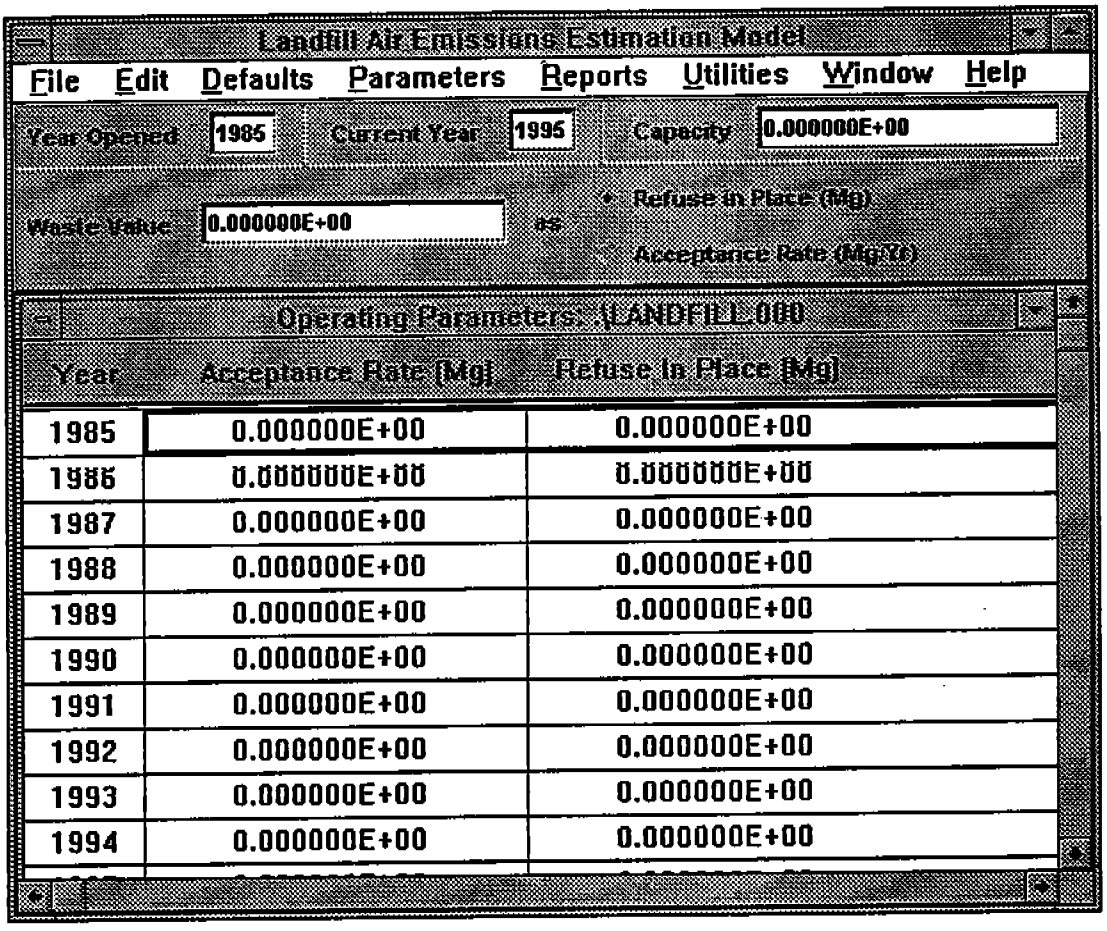

Figure 1. The document window for the landfill study documents

3.1.1 Document Windows

Each landfill study appears in its own window. Document windows have the same display features as any other windows in Microsoft Windows. You can scroll through, switch between, size, move, or close document windows just as you can application and other windows. You can open many windows on the screen at one time. However, you can work in only one window at a time. The window in which you are currently working is called the active window. The active window will have a title bar of a different color from the inactive windows.

3.1.2 Closing a Document Window

You can close a document window at any time and remove it from the work space. Any program or document can be closed and removed from the work space by double clicking on the button in the top left corner of the window application or document window. Note: Any time you close a document before saving changes, the program displays a message asking whether you want to save the changes. Choose the [Yes] button to save changes, the [No] button to cancel changes to the document, or the [Cancel] button to cancel the Close command.

To close a document window:

Double click the close box in the upper left corner of the document window or choose Close from the File menu.

3.1.3 Working with Document Windows

You can have several document windows open at one time (Figure 2). The title bar on the active document is usually a different color from the other document window title bars. All open document windows are listed on the Window menu. You can switch to a window directly by clicking it with the mouse, or by choosing its name from the list on the Window menu.

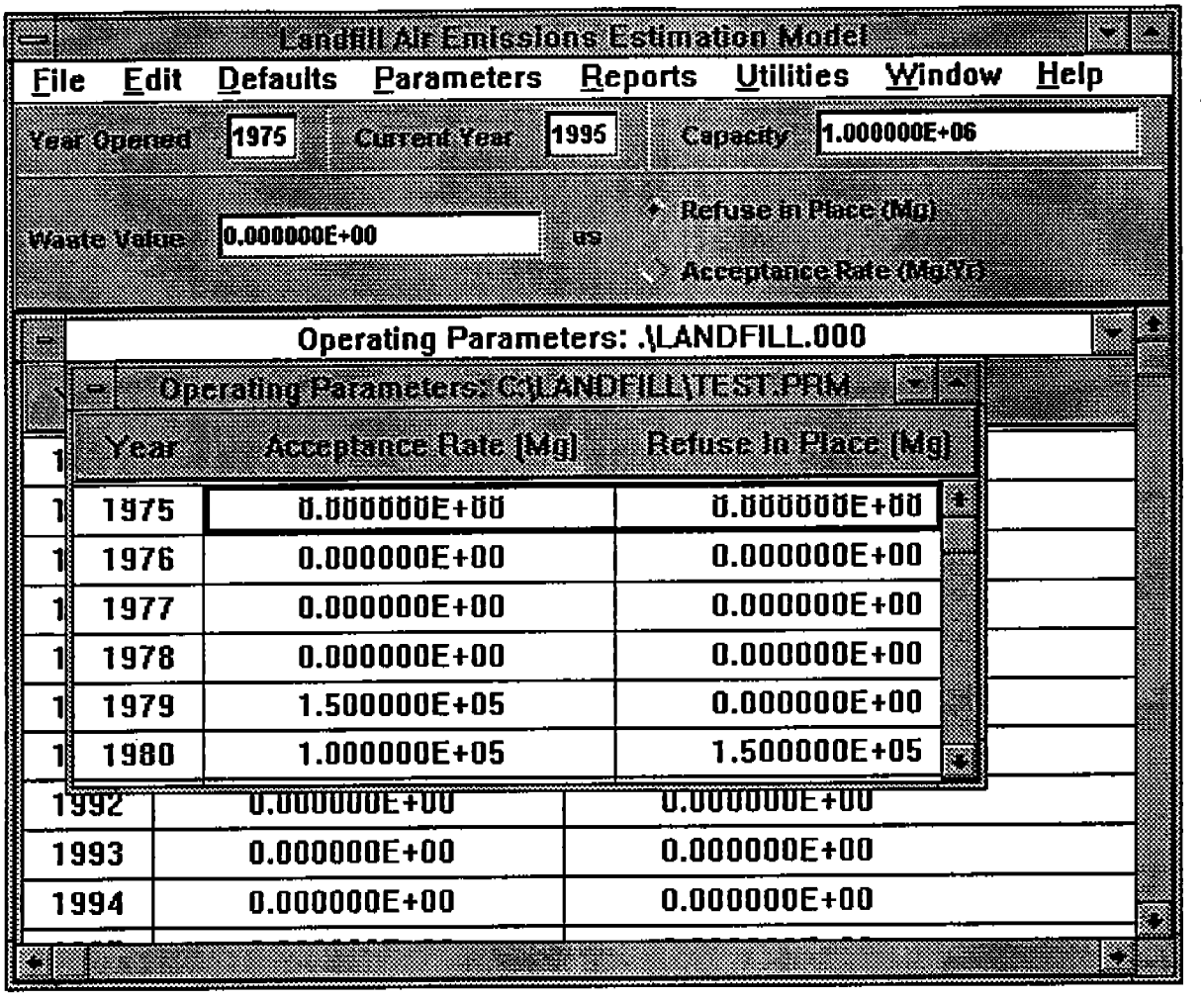

Figure 2. Landfill study with several open document windows

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1. To switch to a visible document window, click the document window. The document you click becomes the active document and overlaps all other document windows.

2. To switch to a document window that is behind other windows, go to the Window menu and select the name of the document. (All open documents are listed at the bottom of the Window menu.)

3. To arrange all document windows in the work space, from the Window menu, choose Tile or Cascade. Tile can be vertical or horizontal and places windows adjacent to each other. Cascade overlaps them with their title bars and main menus showing.

3.2 Menus

Commands for the program are grouped into menus. The menu names appear in the menu bar displayed across the top of the application window. Different functions of the program have different menus. For example, the initial menu includes the File menu, for opening and saving files or exiting the program, and the Utilities and Help menus. The Utilities and Help menus are available with every function in the program. When you open a landfill study, the complete Main Menu for this program appears, containing the menu items listed in Table 1.

3.2.1 Using the Menus

When you choose a command name that is followed by an ellipsis (...), the program displays a dialog box so you can enter more information or select more options before the program will carry out the command (Figure 3).

Some command names occasionally appear dimmed. This indicates that the command does not apply to the current situation or that you may need to make a selection or complete an action before choosing the command.

Table 1. Main Menu for the Windows Program

Menu Item	Description
File	For managing files or exiting the program: creates a new or opens an existing file, saves updated files, sets system options, including the calculation defaults (CAA, AP-42, or user specified) and the years past landfill closure for which the system will calculate emissions, or exits the program.
Edit	For moving material: cuts, copies, and pastes data or text.
Defaults	For setting default values for the constants used in the program calculations: selects CAA or AP-42 default values, or sets user-defined default values.
Parameters	For setting the user-defined default values for constants used in calculation, selecting whether the landfill was ever used to dispose of hazardous waste (codisposal) or not (no codisposal), and setting default concentrations for toxic air pollutants in the landfill gas.
Reports	For printing the report of the emission estimates for a pollutant over the life of the landfill and for a selected number of years after closure. The report can be printed as a table (in text format) or a graph (in graphics format).
Utilities	For manipulating data to put it in a form that can be used in the program. Offers conversion of units from English to metric units or estimation of refuse in place from the dimensions of the landfill.
Window	For controlling the placement of windows within the application window. Tiling places windows adjacent to each other, either horizontally or vertically. Cascade overlaps windows with menu bars visible. Any open window is listed in the window menu and can be made active by selecting its name on the list.
Help	For on-screen help.

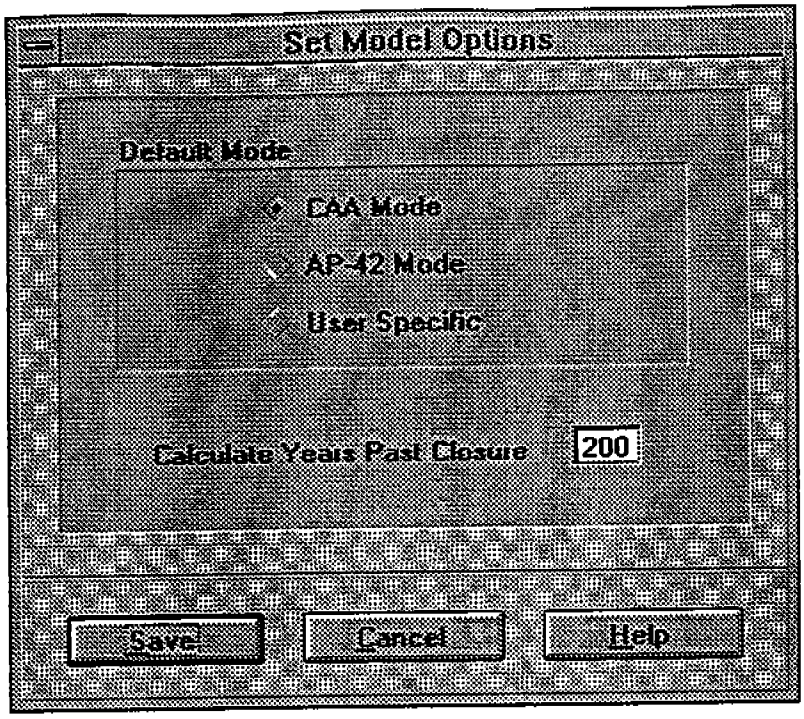

Figure 3. Example dialog box

To choose a menu command, point to the menu name in the menu bar that contains the command you want, drag the mouse to that command, and then release it to select the command. You can also click on the menu name, and then click on the command in the menu you want. If the command displays a dialog box, specify the information needed. When you finish with the dialog box, click the appropriate command button to carry out the command. In most cases, clicking the [OK] button carries out the command. In a few cases, the command button that carries out the command may be labeled with a term such as [Convert] or [Save].

3.2.2 Using the Dialog Boxes

When you choose a command that has options, the program displays a dialog box. The dialog box may include areas in which you type text or numbers and view or change settings for options related to the command. It may also display additional information or request confirmation. Whenever you don't understand an option in a dialog box, select the [Help] button. Help specific to that program function will appear.

3.3 Help Screens

In addition to this printed manual, you also have online help. Help is available by choosing the [Help] button in any dialog box or by choosing the Help menu. When a Help window is active, the menu bar changes to display the Help menu bar.

You can get help from a specific dialog box or message box by pressing the [Help] button. These buttons will bring up Help information specific to the function of the dialog box or message box in which you are working. You can also get help from the Help menu.

For help on using Help, from the Help menu within any Help screen, choose How to Use Help. To exit Help, click on the close button in the upper left hand corner of the Help window or choose Close from the File menu in the Help menu bar. To move backward through Help, choose the [Back] button.

4.0 ESTIMATING LANDFILL EMISSIONS USING THE WINDOWS VERSION

4.1 Opening a Landfill Study

In this program, a landfill study is the primary document used to store and manipulate data. Each study contains the operating parameters for a landfill, based on the years the landfill has been open and the rate of refuse accepted each year. A landfill study also contains the parameters necessary to estimate emissions, including user-specified or default values for k and Lo, concentrations of NMOC, and concentrations of toxic air pollutants.

The landfill study table is displayed in an Operating Parameters document window. The Operating Parameters document window can be moved and sized as can any other window. This allows you to view more than one landfill study document in the work space at a time. You can also open other windows as you create or edit the landfill study, such as the window for reporting emissions for that study or a window for converting units.

4.1.1 Opening a New Document

Use the New command on the File menu to open a new landfill study document.

To open a new document:

1. Select New from the File menu.

   The landfill study document appears in the window, with a data entry box across the top for entering the landfill study data. The document is set up as a table with two columns: one for years and one for refuse in place. All data entered in the data entry box will appear in the active cell of the table. The active cell of the table is highlighted with a bold outline.

2. New documents can be opened at any time in addition to the documents already opened.

4.1.2 Opening an Existing Document

Use the Open command on the File menu to open an existing landfill study document.

To open an existing document:

1. Choose Open from the File menu.

   The Load a Landfill Study dialog box appears (Figure 4). The dialog box lists the documents that are in the current directory (the working directory). The documents created in this program will be saved by default to the working directory; however, if you prefer, you can specify a different drive and directory to which to save files. Landfill scenarios are saved with a .PRM extension on the filename.

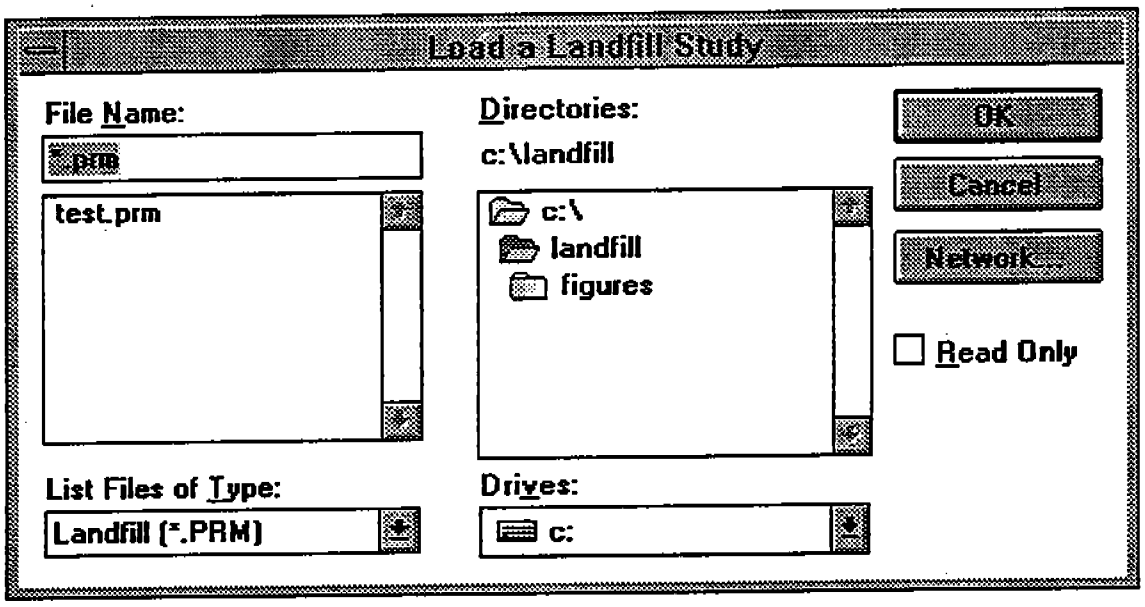

Figure 4. The Load a Landfill Study dialog box, for opening an existing study

2. Select the document you want to open.

   In the dialog box, you can select a different drive and directory from which to load files or type the complete path and filename in the File Name text box. Existing landfill study documents can be loaded as read only files; that is, they can be

loaded so that the data in them can be read but not changed. To do this, click the mouse pointer in the Read Only box.

3. Select [OK] to open the document.

4. If you do not want to open the document, select [Cancel].

4.2 Selecting Model Parameters for Calculating Emissions

The Landfill Air Emissions Estimation Model will provide estimates of emissions based either on user-specified values for the parameters needed or on system default values. Selecting the option to create user-specified values allows the user to specify the k, Lo, and NMOC concentration, to specify toxic air pollutant concentration values, or to create these values from landfill-specific test data. If no user-specified data are available, there are system default values for k, Lo, NMOC concentration, and toxic air pollutant concentrations. The program provides two sets of system default values: the CAA defaults and the AP-42 defaults:

- The CAA defaults are for estimating emissions to assess the applicability of the NSPS for new MSW landfills and emission guidelines for existing MSW landfills (40 CFR 60 subparts Cc and WWW). In general, the CAA defaults take into account the requirements of the regulations and produce more conservative emissions estimates than the AP-42 default values; and

- The AP-42 defaults are for estimating emissions for inventories. The AP-42 default values are derived from Chapter 2.4 in AP-42, Emission Factors for Estimating Emissions from Solid Waste Disposal in Landfills (EPA, 1995).

EPA has proposed updated values for landfill emissions for a revision of AP-42. The value currently in this model are the draft AP-42 values.

4.2.1 Choosing Default Parameters

The Defaults menu is for choosing default or user-specific values for the parameters used in the calculations to estimate landfill emissions. The Landfill Air Emissions Estimation Model requires two parameters to calculate the amount of methane generated by the landfill: the k value, the methane generation rate constant, and the Lo value, the potential methane generation capacity. The k and Lo values can be specified by the user, calculated from test data, or set as system default by choosing by the CAA and AP-42 system defaults. The current k and Lo default values, which could change if new values are developed by EPA, are the following:

CAA defaults:

k 0.05 1/yr

Lo 6000 ft^3 CH_4/Mg of refuse (169.9 m^3/Mg of refuse)

AP-42 defaults:

k 0.04 1/yr

Lo 4411 ft^3 CH_4/Mg of refuse (124.9 m^3/Mg of refuse)

Users can specify landfill-specific k and Lo values (Figures 5 and 6) based on field data or other information. The user-specified methane generation rate (k) values can be typed in or calculated. To calculate k values, the program requires test data. If a user has tested for landfill gas emissions using EPA Method 2E, the method for Determination of Landfill Gas Production Flow Rate, the results of the Method 2E testing can be entered into the program, and the program will calculate a k value based on the test results.

User-specified potential methane generation capacity (Lo) values can be typed in. The value for potential methane generation capacity (Lo) depends only on the type of refuse present in the landfill. The higher the cellulose content of the refuse, the higher the value of Lo.

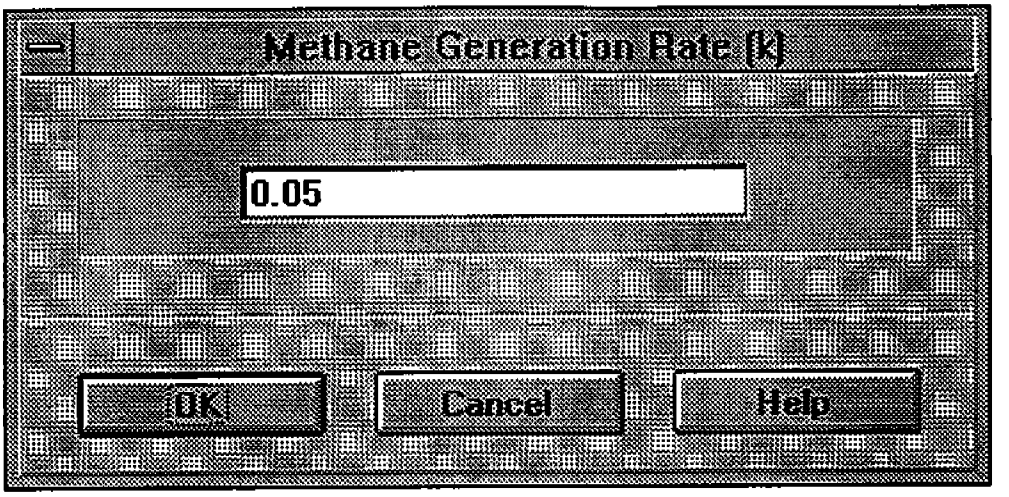

Figure 5. Dialog box for entering user-specified k values

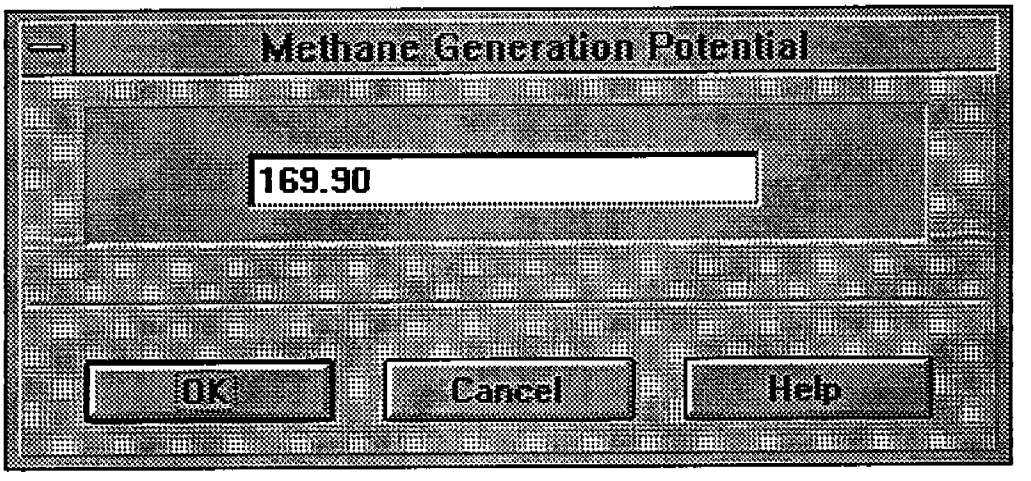

Figure 6. Dialog box for entering user-specified Lo values

The values of theoretical and obtainable Lo reported in test data compiled in AP-42 range from 220 to 9540 ft^3 CH_4/Mg (6.23 to 270 m^3/Mg) of refuse (EPA, 1995).

In addition to setting the values of k and Lo, selecting CAA or AP-42 defaults specifies a default concentration for NMOC (measured as hexane) in the landfill gas. The default NMOC concentrations used for the AP-42 system defaults are different for landfills used to dispose of hazardous waste (landfills with codisposal) and clean landfills (landfills with no codisposal). The default NMOC concentrations are:

CAA defaults:

4000 ppmv of NMOC

AP-42 defaults:

2420 ppmv of NMOC (with codisposal of hazardous waste)

595 ppmv of NMOC (with no codisposal)

To set the system defaults:

1. For CAA defaults, select CAA in the Defaults menu. Or select Options .... in the File menu and select CAA Mode.

2. For AP-42 defaults, select AP-42 in the Defaults menu. Or select Options.. in the File menu and select AP-42 Mode

3. For user-specified system parameters, select User Specific in the Defaults menu. Or select Options .... in the File menu and select User Specific. The user-specified parameters must be set in the Parameters menu.

4.2.2 Setting User-Specified Parameters for k and Lo

The Parameters menu is for setting four kinds of system parameters: user-specified values for k or Lo values, hazardous waste codisposal, user-specified values for pollutant concentrations present in the landfill gas, and the closure year for the landfill. The File menu is

used for setting the number of years past landfill closure for which the program will estimate emissions.

Setting k and Lo Values

To set user-specified values for k:

1. Select the Parameters menu.

2. Select the Decay (i.e., Methane Generation) Rate (k).

3. Select User Specified ...

   A dialog box will open in which a specific Methane Decay Rate (k) can be entered (see Figure 9).

4. Or select Calculated ...

   A dialog box (the Method 2E Calculator, Figure 7) will open in which to enter the results of testing by EPA Reference Method 2E (Determination of Landfill Gas Production Flow Rate). You must have done landfill gas flow rate testing to have the information necessary to calculate a k value. All of the parameters must be non-zero in order for a value of k to be calculated. The calculated value of k can be changed simply by changing one of the input parameters and pressing [ENTER]. The dialog box will request the following information:

   Average Well Depth (m)
   Average Stabilized Radius of Influence (m)
   Refuse Density (Mg/m^3)
   Fraction of Decomposable Refuse
   Methane Generation Potential (Lo) in m^3/Mg
   Average Stabilized Flow Rate per Well (m^3/min)
   Average Age of Refuse (years)

   All values need to be non-zero for the Method 2E Calculator to work.

5. After these values are entered, select [Calculate]. The program will calculate a k-value.

The methane generation potential (the Lo value) can also be specified by the user (see Figure 6).

To set user-specified values for Lo:

1. Select the Parameters menu.

2. Select Generation Potential (Lo).

3. Select User-Specified ...

   A dialog box will come up in which you can enter a value for Lo. Enter a value. Select [OK].

To return to default system parameters for k and Lo:

1. Select Default CAA or Default AP-42 in the Parameters menu, or

2. Select Options ... in the File menu and select CAA Mode or AP-42 Mode (see Figure 3), or

3. Select CAA or AP-42 in the Defaults menu.

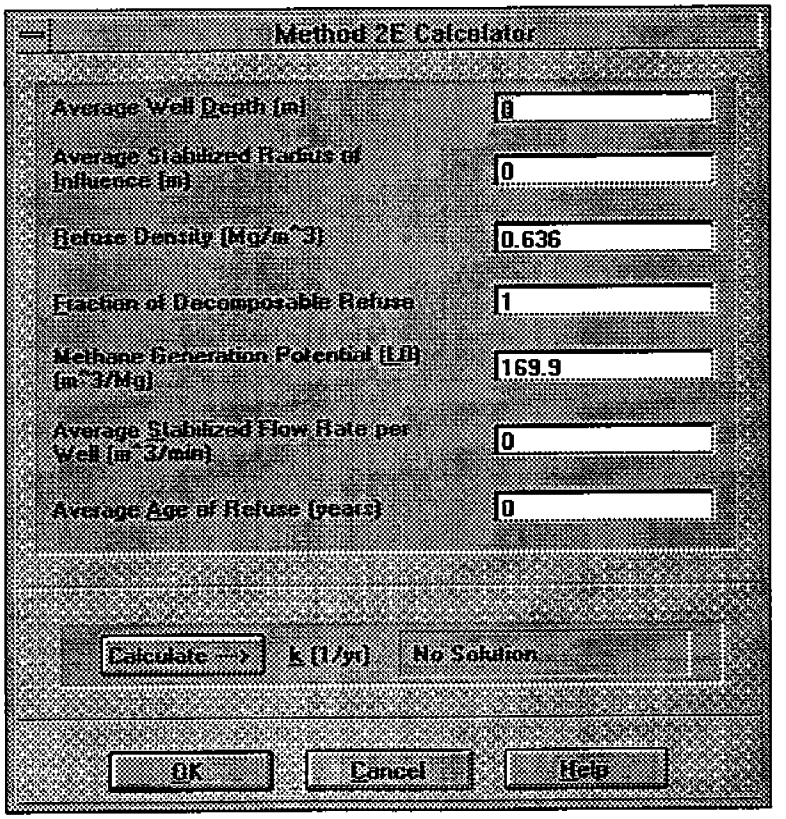

Figure 7. The Method 2E Calculator for calculating k values from test data

652-015-59-02\Landfil3\tom
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4.2.3 Setting File Defaults and the Calculated Years Past Closure

Some system defaults can be set from the File menu: the default parameters for a new file and the number of years past closure.

File Defaults: The default parameters chosen for a new file can be modified with the Options command under the file menu. This option is designed to allow the user to customize the system for the generation of new studies and reports.

To change the default parameters for a new file:

1. Select the File menu. Choose Options ...
2. Select the data set (CAA, AP-42, or User-Specific) that you wish to be the source of default values in all new files.
3. Select [Save]. Any changes will take effect on the next file opened.

Calculated Years Past Closure: Landfill gas continues to be produced from decomposing refuse even when no new refuse is being added to the landfill; therefore, the Landfill Air Emission Estimation Model estimates emissions from the landfill up to the closure of the landfill and for a certain number of years past closure. By default, the model will estimate emissions for 50 years past closure, however the length of this estimation period can be changed.

To change the number of years past closure for which the program will estimate emissions:

1. Select the File menu.
2. Select Options .....

   A dialog box will appear in which you can select system default options (CAA, AP-42, or user-specified) and select the number of years past closure for which the program will estimate emissions (see Figure 3).

3. Select the text box for Calculate Years Past Closure.

4. Type the desired number of years.

5. Select [Save] to save that option for the specific landfill study. New landfill studies will open with the number of years past closure set at the default value of 50 years.

   Select [Cancel] to keep the default value.

4.2.4 Setting the Landfill Type

The Parameters menu is also used to select the default values related to Superfund sites or sites where there is a known history of codisposal (i.e., landfilling of hazardous waste along with municipal solid waste (MSW)).

To set values that assume codisposal of MSW and hazardous waste in the landfill:

1. Select the Parameters menu.

2. Select Landfill Type/Codisposal.

To set values that assume no codisposal in the landfill:

1. Select the Parameters menu.

2. Select Landfill Type/No Codisposal.

Hazardous waste codisposal status has been found to make no difference in the concentration of most toxic air pollutants in landfill gas. However, for benzene and toluene, the concentration in the landfill gas is higher for landfills with hazardous waste codisposal than for landfills with no hazardous waste codisposal. To reflect this difference, the AP-42 default value

for NMOC is affected by a landfill's codisposal status: The concentration of NMOC in the landfill gas is higher for a landfill with "Codisposal" status than for a landfill with "No Codisposal" status. The CAA default value for NMOC is the same regardless of a landfill's codisposal status. However, for both the AP-42 and CAA defaults, the factors used to calculate the concentrations of benzene and toluene in the landfill gas are greater for landfills with codisposal than for those with no codisposal.

For each study, the user must indicate the codisposal status of the landfill. The model does not provide an option for unknown codisposal status. If the user do not know whether a landfill contains hazardous waste, then the user should select the worst-case option, which is codisposal, for determining the default values of NMOC. However, AP-42 concentrations for benzene and toluene in landfills of unknown hazardous waste disposal status are available and should be used when the codisposal status is unknown. The AP-42 concentrations for these toxic pollutants are 30 ppmv for benzene and 165 ppmv for toluene. To enter concentrations for benzene and toluene for landfills of unknown codisposal status, follow the procedures for editing air pollutants in section 4.2.6 of this manual.

4.2.5 Setting Pollutant Concentrations in the Landfill Gas

The Parameters menu is used to set the concentrations of CH_4, CO_2, NMOC, and toxic air pollutants in the landfill gas. The default concentrations for CH_4 and CO_2 are 50 percent each. These percentages can be changed for a specific landfill study.

To edit the concentrations of CH_3 and CO_2 in the landfill gas:

1. Select the Parameters menu.
2. Select Air Pollutants ...

A dialog box will come up for defining the pollutant concentrations in the landfill gas (Figure 8).

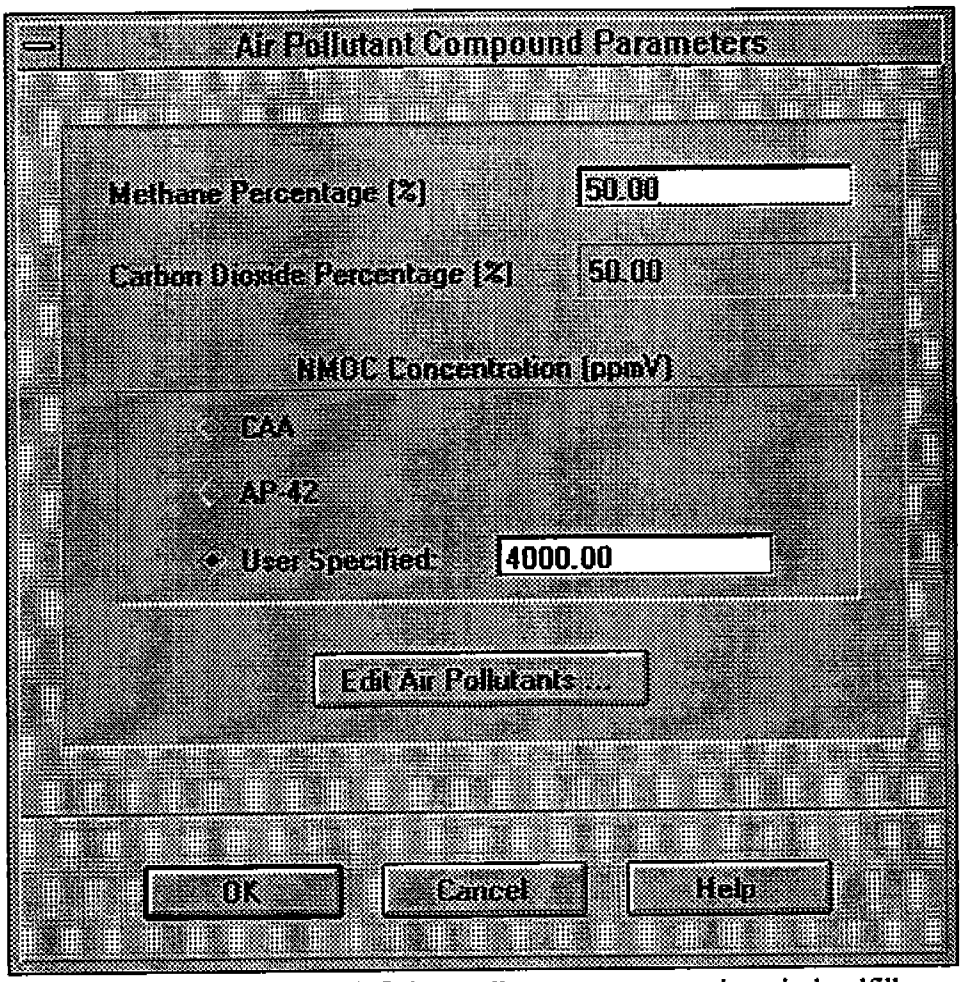

Figure 8. Dialog box for defining pollutant concentrations in landfill gas

Select the Methane Percentage (%) text box to enter a methane concentration. Select the Carbon Dioxide Percentage (%) text box to enter a carbon dioxide concentration. The default values of 50 percent can be overwritten. The percentages should add up to 100 percent, as the concentrations of NMOC and toxic air pollutants in landfill gas are trace amounts.

NMOC concentrations are related to the system defaults. Selecting CAA or AP-42 defaults specifies a concentration for NMOC (measured as hexane) in the landfill gas. If the CAA system defaults are selected, the NMOC concentration will be the CAA default value, and other selections in the dialog box for selecting pollutant concentrations will be dimmed; (that is, they can't be used). Selecting the AP-42 defaults has a similar effect. The default NMOC concentrations are as follows:

CAA defaults:

4000 ppmv of NMOC

AP-42 defaults:

2420 ppmv of NMOC with codisposal of hazardous waste

595 ppmv of NMOC with no codisposal of hazardous waste

If the system defaults are user specified, then the NMOC concentration is user specified.

To set a user-specified concentration of NMOC in the landfill gas:

1. Select the Parameters menu.
2. Select Air Pollutants...

   A dialog box will come up for defining the pollutant concentrations in the landfill gas (see Figure 8).
3. Select the button for User Specified in the NMOC Concentration box.
4. Select the User Specified text box and enter a value.
5. Select [OK] to accept the value.

4.2.6 Editing Air Pollutant Information

Default concentrations for a selected list of toxic air pollutants in the landfill gas are set under the CAA or AP-42 system defaults and codisposal or no codisposal options. The default values for concentrations of toxic air pollutants are based on test data available for toxic air pollutants found in landfill gas. There are 46 toxic air pollutants included in the program, taken from the EPA landfill emissions estimation material in AP-42 (EPA, 1985). These concentrations were summarized in developing CAA air emission rules (Docket A-88-09) and used in developing the updated AP-42 emission factors.

The AP-42 data provide concentration ranges for 39 toxic air pollutants under two different operating conditions: when hazardous waste has been discarded in the landfill (codisposal), and when no hazardous waste has ever been discarded in the landfill (no codisposal). As a reminder from section 4.2.4, for most toxic air pollutants, hazardous waste codisposal makes no difference in the concentration of the toxic air pollutants in the landfill gas. However, for pollutants, such as benzene and toluene, for which the parameters do differ based on landfill type or for pollutant for which the user wishes to enter specific parameters, the pollutant concentrations can be modified. In addition, information can be added for other pollutants not in the default list of 46 chemicals. The program can accommodate up to a total of 60 toxic air pollutants. If information is available on the landfill gas concentration of a particular toxic air pollutant that is not included in the list of 46 toxic air pollutants, the additional pollutant can be added to the program.

For a specific landfill study, the default values for toxic air pollutants concentrations can be overwritten for any individual toxic air pollutant, and toxic air pollutants can be added to or deleted from the list included in the program. To add a pollutant to the list, the user must know the name of the pollutant, its molecular weight, and its concentration in a landfill with codisposal and with no codisposal. Then a record for this pollutant can be appended to the list of 46 toxic air pollutants. Pollutants can also be deleted from the default list for a specific landfill study.

It is recommended that all landfills obtain data on the composition of toxic air pollutants in the landfill gas using EPA Method 18 in the Code of Federal Regulations (40 CFR Part 60, Appendix A), as recommended by EPA's Source Characterization Group of the Office of Air Quality Planning and Standards. Codisposal or Superfund sites should use the upper end of any range of potential air pollutant concentrations.

To edit, add, or delete an entry for an air pollutant:

1. Select the Parameters menu.

2. Select Air Pollutants...

3. Select [Edit Air Pollutants ...].

   A Selected Air Pollutants dialog box will appear (Figure 9).

4. To edit the concentration for a pollutant, move through the listing using the arrow buttons. The [>] or [<] keys move one entry forward or back. The [>|] or [|<] keys move to the beginning or the end of the list. The pollutants are listed alphabetically; any pollutant whose name begins with a number will be listed first.

5. In the Selected Air Pollutants dialogue box, the user can edit existing air pollutants, add air pollutants to the list, or delete pollutants from the list.

   Editing Existing Pollutant Information
   Information in the model for a pollutant can only be changed by adding another record for the same pollutant. The program is capable of handling records for pollutants with the same name. Therefore, to "edit" the information for a pollutant, follow the procedures in the next paragraph for adding a pollutant to the list. When generating a report, be sure to select the record with the pollutant parameters you want.

   Adding a Pollutant to the List
   Select the Name text box, and type the name of the pollutant you wish to add. Then select the Molecular Weight text box and enter the pollutant's molecular weight. Select the Codisposal Concentration text box and enter the concentration of that pollutant in a landfill with codisposal of hazardous waste. If there is no codisposal, select the No Codisposal text box and enter the concentration of that pollutant in a landfill with no codisposal of hazardous waste. After all the information for a new record has been entered, select the [Append] button to add the pollutant to the list. This new, appended, pollutant will not be alphabetical and will be added to the end of the list (e.g., Entry 47 of 47).

Deleting a Pollutant from the List
When the pollutant to be deleted is displayed in the Selected Air Pollutants dialog box, press [Delete]. That pollutant will be deleted from the list of air pollutants included in the emission estimates for that landfill study

6. When you have finished editing the list, press [OK].

The default list of air pollutants cannot be altered permanently. When a new landfill study is opened, the list of toxic air pollutants included will default to the original list of 46 pollutants. No changes (edits, additions, nor subtractions) made to this list in previous files will be present. Table 2 lists the 46 default pollutants included in the model.

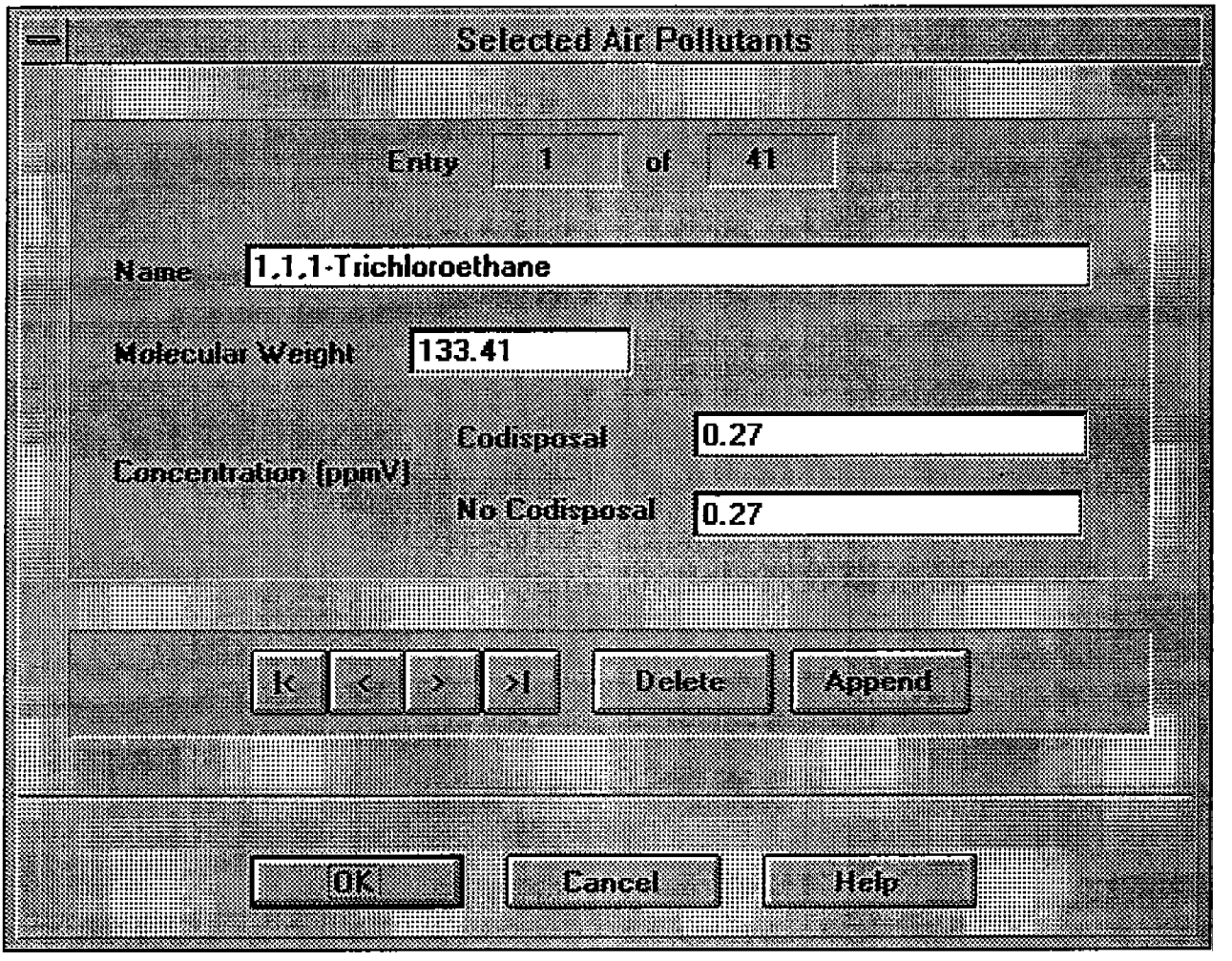

Figure 9. Dialog box for defining the concentrations of selected air pollutants in landfill gas

652-015-59-02\Landfil3\tom
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Table 2. Pollutants Included in Landfill Air Emissions Estimation Model

Chemical	Molecular Weight	Concentration (ppmv)	
		Codisposal	No Codisposal
1,1,1-Trichloroethane	133.41	0.48	0.48
1,1,2,2-Tetrachloroethane	167.85	1.11	1.11
1,1,2-Trichloroethane	133.41	0.1	0.1
1,1-Dichloroethane	98.96	2.35	2.35
1,1-Dichloroethene	96.94	0.201	0.201
1,2-Dichloroethane	98.96	0.407	0.407
1,2-Dichloropropane	112.99	0.171	0.171
2-Propanol	60.11	50.06	50.06
Acetone	58.08	7.01	7.01
Acrylonitrile	53.06	11.5	11.5
Benzene	78.12	30	1.91
Bromodichloromethane	163.83	3.13	3.13
Butane	58.12	5.03	5.03
Carbon Disulfide	76.14	0.583	0.583
Carbon Monoxide	28.01	309.32	309.32
Carbon Tetrachloride	153.84	0.004	0.004
Carbonyl Sulfide	60.07	0.49	0.49
Chlorobenzene	112.56	0.254	0.254
Chlorodifluoromethane	86.47	1.21	1.21
Chloroethane	64.52	1.37	1.37
Chloroform	119.38	0.019	0.019
Chloromethane	50.49	1.21	1.21
Dichlorobenzene	147	0.213	0.213
Dichlorodifluoromethane	120.91	15.7	15.7
Dichlorofluoromethane	102.92	4.4	4.4
Dichloromethane	84.93	14.3	14.3
Dimethyl Sulfide	62.13	7.82	7.82
Ethane	30.07	1105	1105
Ethanol	46.08	27.2	27.2
Ethylbenzene	106.17	4.61	4.61
Ethyl Mercaptan	62.13	2.28	2.28
Fluorotrichloromethane	137.37	0.756	0.756
Hexane	86.18	6.57	6.57
Hydrogen Sulfide	34.08	35.5	35.5
Mercury	200.61	0.107	0.107
Methyl Ethyl Ketone	72.11	7.09	7.09
Methyl Isobutyl Ketone	100.16	1.21	1.21
Methyl Mercaptan	48.11	4.33	4.33
Pentane	72.15	3.29	3.29
Perchloroethylene	165.83	3.73	3.73
Propane	44.1	11.1	11.1
Toluene	92.14	165	39.3
Trichloroethene	131.29	2.82	2.82
t-1,2-Dichloroethene	96.94	2.84	2.84
Vinyl Chloride	62.5	7.34	7.34
Xylene	106.17	12.1	12.1

652-015-59-02\Landfil3\tom
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4.3 Defining the Operating Parameters of the Landfill

The following data entry pattern is recommended when entering parameters into the computer model: select the Year Opened; then select the final year for which information is available (Current Year); make any changes to the Closure Year that are needed (see section 4.3.3); enter the Landfill Capacity; and enter the Acceptance Rate or Refuse in Place data (see section 4.3.2). With the exception of the requirement that the landfill capacity must be entered before any waste data, recommended order of entry is not required.

4.3.1 Specifying Model Parameters (Years of Operation and Landfill Capacity)

The first data to enter are the number of years the landfill has been in operation and the refuse capacity of the landfill.

To enter the year the landfill opened into a landfill study:

1. In the data entry box across the top of the landfill study document, select the Year Opened text box and type the year the landfill opened.

   The default value for the year opened will be 10 years before the current year. The current year is read from the computer's clock. The default value for the year opened can be deleted and replaced with the appropriate year.

2. The landfill study table will automatically list all the years from the year opened to the current year.

The design capacity of the landfill is the maximum amount of refuse, in megagrams (Mg), that can be accepted by the landfill. This can be calculated using the refuse estimator utility if only the dimensions of the landfill are known. The design capacity of the landfill cannot be zero.

To enter the design capacity of the landfill:

1. Select the Capacity text box and enter the design refuse capacity of the landfill, in Mg.

2. If the value available for the landfill capacity is in tons or other units, convert the value to Mg using the unit conversion utility in the Utilities menu (see section 4.4.1).

3. If no value is available for capacity, but the landfill dimensions are available, use the refuse estimator utility to estimate the refuse capacity (see section 4.4.2).

4.3.2 Entering Acceptance Rates or Refuse in Place

The next data to enter are the acceptance rate or refuse in place data for the years the landfill has been in operation. Before entering these data in the data entry box, select the cell of the landfill table with which to work. Use the mouse to click on the cell into which you wish to enter data. The cell you chose becomes the "active cell." The active cell will be highlighted by a bold border (Figure 10), and the contents of the active cell will appear on the command bar in the Waste Value box. The procedure below describes how to select a cell for data entry and how to enter refuse data.

To select a cell in the landfill study table you want to work with:

Use the mouse to click on the year for which you wish to enter refuse data or use the cursor motion keys ([↑], [↓], [Page Up], or [Page Down]) to move the highlight in the table to the desired cell. To enter or change a value, highlight the content of the Waste Value box. Any value in this Waste Value text box can be edited, deleted, or overwritten, and the changes will propagate into the table below.

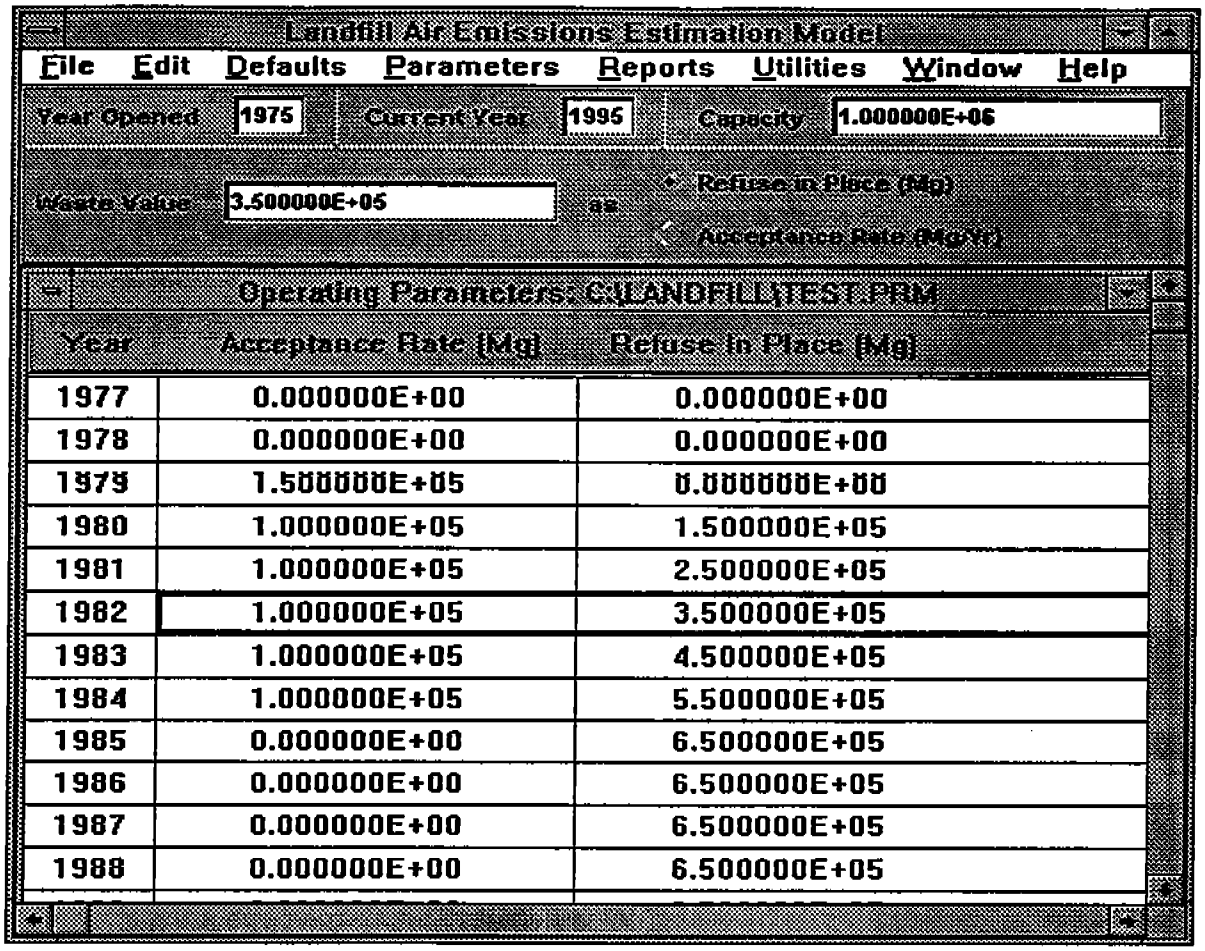

Figure 10. The active cell of the Operating Parameters table will be highlighted.

The landfill history data is comprised of yearly total refuse data for the years of operation. Initially, all refuse values are zero. The refuse data is verified for validity before emissions will be estimated by the program and produced in a report.

To enter refuse values:

1. Select the landfill study window in which you wish to enter refuse data.

2. Select the year for which the data are to be entered in the Landfill Study table.

The cell for that year will be highlighted by a bold border. The waste value you type in the data entry box will be entered into this cell of the table.

3. Enter a Waste Value in the text box.

To enter data in the cell of the landfill study table, select the cell in which you want to enter a value. Highlight the contents of the Waste Value box, and then type in the value for the refuse. Press [Enter] to confirm the value and accept it in the table. The value entered will appear in the active cell.

Refuse values can be entered into the landfill study table as either total refuse in place in the landfill (in Mg) or an annual acceptance rate (in Mg/yr), depending on the button that is selected next to the Waste Value text box. If the available refuse data for the landfill are for the amount of refuse in place, select the Refuse in Place (Mg) button. If the available refuse data for the landfill are annual acceptance rates, select the Acceptance Rate (Mg/Yr) button. Please note that the refuse in place for each successive year cannot be less than the previous year's refuse in place and must always be less than or equal to the design capacity.

Waste Value as Refuse in Place
If the waste value is a value for refuse in place (i.e., if the Refuse in Place button is selected), the value will be entered for the selected year. It is assumed that the user has estimated the refuse present in the landfill. The Waste Value you enter will replace any current refuse in place number for that year. To avoid a logical error, you must enter a Waste Value greater than the current refuse in place, because refuse in place is cumulative. If the refuse in place value you enter is larger than the value for the following year, the larger value will automatically be entered as refuse in place for subsequent years in the table until a year in which the value in the table is larger.

Waste Value as an Acceptance Rate
If the waste value is an acceptance rate (i.e., if the Acceptance Rate button is selected), the value for this amount of waste will be added to the refuse in place for the year following the selected year. The model calculates emissions based on the waste present at the beginning of the year. The value for refuse in place is treated as the refuse in place at the beginning of the year. The value for the waste acceptance rate is treated as the total amount of waste accumulated during the year, and, as such, does not appear as refuse in place until the following year. After a waste acceptance rate has been entered, the total refuse accumulated propagates throughout

the years of operation and becomes the refuse in place for all subsequent years in the table.

4. To edit an entry: Once a refuse value has been entered, you can easily change a cell entry by typing a new entry over an existing one, or by editing part of the cell entry (see section 4.3.4).

After entering the refuse in place data for all years known, the can will use the last acceptance rate value entered, assume that the acceptance rate for all following years will be that value, and project the year the landfill will reach its design capacity and close if refuse is accepted at that annual rate. This functionality, the Closure Year, is described in more detail in the next section.

4.3.3 Closure Year

The Closure Year function is located under the Parameters menu. This function allows the user either to calculate the closure year automatically or to specify an actual closure date for the landfill. The default option is for the model to calculate the closure year automatically. That is, if the user does not specify a closure date for the landfill, the computer model will calculate the closure year. In either case, the landfill model will treat the closure year as the year at which the landfill waste accumulated reaches the capacity of the landfill.

System Calculated Closure Year: The computer model calculates the closure year based on the amount of waste accepted in the last year for which data has been entered, and making a projection based on the capacity of the landfill. After the computer determines what the most recent non-zero acceptance rate is, it assumes that this rate of refuse acceptance is continued throughout the remainder of the life of the landfill. At this assumed acceptance rate, the landfill adds waste to the refuse in place until the year in which the landfill waste in place is equivalent to the landfill capacity. The computer model will assign this final year to the value of the Closure Year.

User-specified Closure Year: If the user does not know the refuse acceptance rates for the final years of the landfill's operation, the user may specify the closure year for the landfill and allow the computer to calculate the acceptance rates until closure of the landfill. Specification of the closure year by the user signals the program to compute the necessary annual waste acceptance rate for each year between the current year and the closure year to achieve the landfill design capacity. The computer model will calculate the acceptance rates for the final years by dividing the remaining capacity of the landfill by the number of years between the current year and the specified closure year.

The user must take caution when specifying the closure year: The closure year of the model must always be one year beyond the current year, even if the current year is the year in which the refuse in place reaches the capacity of the landfill (i.e., a case in which the current year is, by definition, the closure year). If a closure year is chosen that is the same as the current year, the model will not be able to calculate the emissions estimates, and the software application will close.

To set the year of closure for the landfill:

1. Select the Parameters menu.
2. Select Closure Year .... A dialog box will open.
3. Select Calculate if you want the program to average the refuse acceptance rates and apply that acceptance rate to project the year the landfill will reach design capacity and close.
4. Select User-Specified to set a year of closure.
5. Select the Closure Year text box and type in the closure year. The program will calculate the refuse acceptance rate necessary to reach capacity by the specified closure year.
6. Select [OK] to accept the closure year.

If the user supplies a closure year, the program will calculate the refuse acceptance rate necessary to reach the design capacity of the landfill by the year of closure.

The program will predict emissions for a selected number of years past the date of closure. The default number of years is 50, which can be changed in the File/Options dialog box (see section 4.2.3).

4.3.4 Editing Entries

An entry in the landfill study table can be edited, copied, or moved within a table cell or to another cell. The insertion point in the data entry box is at the flashing vertical line indicating the cursor position in a box or text string. The Clipboard is a space in memory to which data can be sent temporarily, as if they were placed in a note on a clipboard, before being moved or copied into the landfill study. An entry in a landfill study can be edited in the data entry box using the following commands in the Edit menu or keys and key combinations:

To edit using the Edit menu, use the following commands:

Cut	Use this command to remove the selected characters from the cell entry and place them on the Clipboard, replacing the Clipboard's contents. After you cut a selection, you can use the Paste command to paste it at the insertion point in the data entry box.
Copy	Use this command to make a copy of the selected characters and place them on the Clipboard, replacing the Clipboard's contents. After you copy a selection, you can use the Paste command to paste it in the data entry box at the insertion point.
Paste	Use this command to place the contents of the Clipboard in the data entry box at the insertion point.

When using the Cut, Copy, and Paste commands to move data from one cell to another, the transfer is easiest when this procedure if followed: highlight the origin cell by

dragging the cursor across the cell with the primary mouse button depressed; select the Cut or Copy command; highlight the contents of the destination cell; and then select the Paste command.

To edit using the keyboard:

[Tab]	toggles the cursor among the data entry boxes on the command bar. When the tab key is used to toggle between boxes, the destination box's contents will be selected when the cursor moves into that box.
[Shift][Tab]	allows the cursor to toggle the opposite direction as the tab key alone.
[Delete]	deletes the character to the right of the insertion point. With characters selected (i.e., highlighted with the cursor), deletes the selection.
[Ctrl][x] or [Shift][Delete]	with characters selected, cuts the selection and places it on the Clipboard.
[Backspace]	deletes the character to the left of the insertion point. With characters selected, deletes the selection.
[Ctrl][v] or [Shift] [Insert]	pastes the data from the Clipboard at the insertion point. With characters selected, replaces the selection with the Clipboard data.
[Ctrl][Delete]	deletes from the insertion point to the end of the line. With characters selected, deletes from the beginning of the selection to the end of the line.
[Ctrl][c] or [Ctrl][Insert]	with characters selected, copies the selection to the Clipboard.

To edit a cell entry:

1. Select the cell of the landfill study table that contains the data you want to change. The value contained in the active cell appears in the data entry box (i.e., the Waste Value box on the command bar).
2. To completely replace the contents of a cell, drag through the characters to highlight the entire entry. Begin typing and the entire contents of the cell will be replaced. To place the cursor at a particular point in the cell, click in the data entry box at the desired insertion point.
3. Edit the cell entry.

4. To enter your edits in the cell, press Enter.

To move or copy cells with the Cut, Copy, and Paste commands:

Moving cells has the same effect as physically cutting the contents of a cell and transferring them to a new location, either on the same study table or on a different study table. Copy or move cells by choosing the Cut or Copy command, followed by the Paste command in the Edit menu.

1. Select the cell you want to copy or move.
2. In the data entry box, select the characters you want to copy or move.
3. If you want to move the selection, choose Cut from either the Edit menu or with the keyboard commands. If you want to copy the selection, choose Copy. If you want to move or copy the contents of a cell to another landfill study, switch to the window with the other landfill study.
4. Select the cell into which you want to paste the characters.
5. If you are copying into a cell that contains data, position the insertion point in the data entry box where you want to paste the characters. If you want to replace the contents of the cell, select or highlight the cell's content with the mouse or the tab key.
6. Choose Paste from the Edit menu or with the keyboard commands.
7. To copy the same information to another location, repeat steps 5 and 6 with a different paste area or destination cell selected.

4.4 Windows Version Utilities

Like Help, the utilities for this program are available from any of the functions of the program. There are two utilities: a Unit Conversion utility and a Refuse Estimator utility.

4.4.1 The Unit Conversion Utility

This program uses metric units (such as megagrams of refuse) rather than English units (such as tons of refuse), because metric units are used by the federal government and for the CAA regulations for MSW landfills. However, users of the model who prefer to use English units can use the conversion utility to convert English units to metric units, or the other way around.

To use the Unit Conversion utility:

1. Choose Unit Conversions from the Utilities menu.

2. Type the units to be converted in the "To convert from" text box.

   The units should be in a format specified by the program. This format is explained in the Help for the Unit Conversion utility. To access Help, press [Help], then choose Unit Formulas in the topics list on the main Help screen. For example, use the symbol ^ to indicate an exponent, * to indicate multiplication, and / to indicate division. The following are several examples of units in formats that will be accepted by the system: kg/m^3; 1.25 kg/m/s; 1.25 kg(m*s)^2.

3. Type the units to which to convert in the "to" text box.

4. Press the [Convert] button.

   The units will be converted (Figure 11). If the units you typed in were units only, with no value, the result of conversion will be a factor by which to multiply the value. If the units you typed in were accompanied by a value (e.g., 35,000 tons) the result will be a converted value (e.g., 31,751 Mg).

5. [Update] will update the units conversion database by adding new units or editing units already included in the conversion database. See below.

6. To exit the Unit Conversion utility, press [Cancel] or double click on the close button in the upper left corner of the utility window.

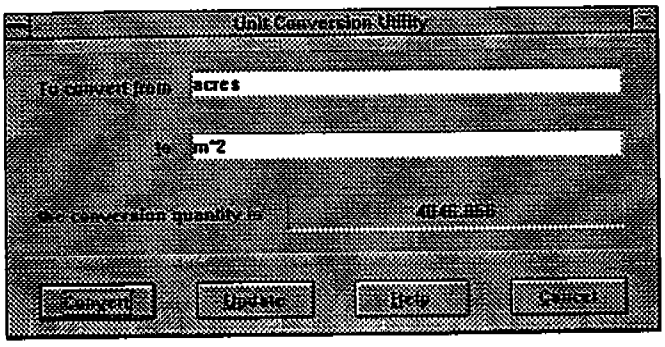

Figure 11. The Unit Conversion Utility dialog box

You can add new units and delete or edit existing unit conversion factors in the Unit Conversion utility with the Unit Database Maintenance facility.

To update the Unit Conversion Utility:

1. Choose Unit Conversions from the Utilities menu.

2. In the Unit Conversions screen, press [Update]. A Unit Database Maintenance dialog box will come up (Figure 12).

3. Type the unit to add to the unit conversion database in the "Unit" text box.

4. Specify whether the unit is case dependent. Metric units, for example, are generally case dependent; mg and Mg are different units. English units are generally not case dependent; ton and Ton are the same unit.

5. Press [Locate] to locate a unit in the database, to be sure the unit is not already there.

6. Type the conversion factor for the unit in the "Factor" text box.

7. Type the metric unit into which the English unit will be converted in the "Base Unit" text box. The base units should be base units in the metric system, if possible (that is, you would use g rather than Mg as a base unit). The base units of the metric system are listed in Help. To access them, press [Help]. Then choose Search Method in the topics list on the main Help screen and "base quantity" highlighted in the Help text. A list of the metric base units and abbreviations for them will appear.

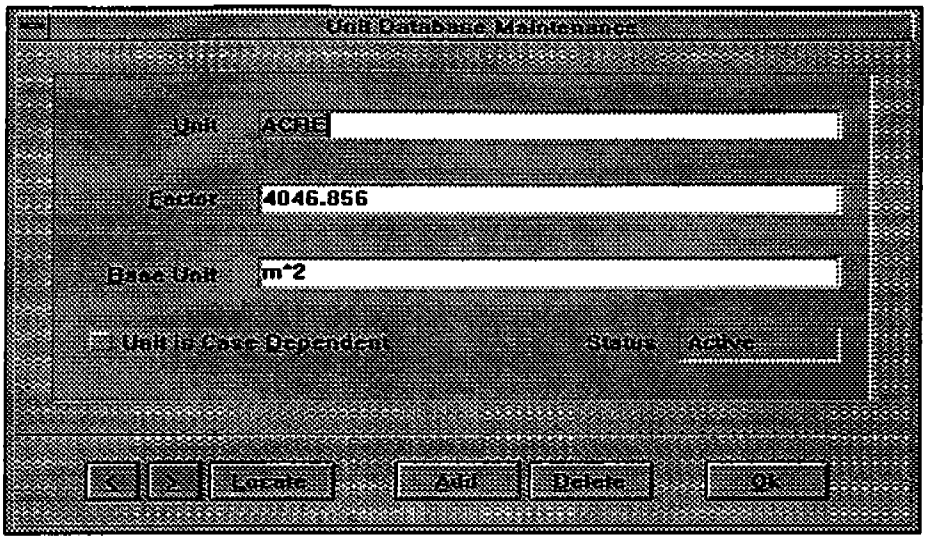

Figure 12. Unit Database Maintenance dialog box, for updating conversion units.

8. Press [Add] or [Delete] to add a unit to or delete it from the conversion database.

9. Updating the conversion database is explained in the Help for the Unit Conversion Utility. To access help for updating the conversion database, press [Help]. Then choose Adding Units or Database Maintenance from the topics list on the main Help screen.

   Adding Units will give help on how to define a new unit to add to the conversion database.

   Database Maintenance will give help on editing the unit conversion database directly, for correcting incorrectly entered units, deleting units, or adding new units.

4.4.2 The Refuse Estimator Utility

This program requires refuse in place or refuse acceptance rates, and calculates emissions using refuse in place. The Refuse Estimator utility allows a user to estimate emissions using this program even if no refuse in place data are available other than the dimensions of the landfill.

To use the refuse estimator:

1. Select Refuse Estimator from the Utilities menu (Figure 13).

2. In the Refuse Estimator dialog box, select the Landfill Size (Acres) text box. If you do not have the size of the landfill in acres, use the Unit Conversion utility to convert to acres.

3. Enter the acreage of the landfill.

4. Select the Landfill Depth (Feet) text box. Enter the depth of the landfill in feet. Use the Unit Conversion utility if necessary to convert the depth to feet.

5. Select [Estimate]. The estimator will estimate the refuse in place in Mg and the value will appear in the Estimated Refuse in Place (Mg) text box.

6. Select [OK] to exit the Refuse Estimator.

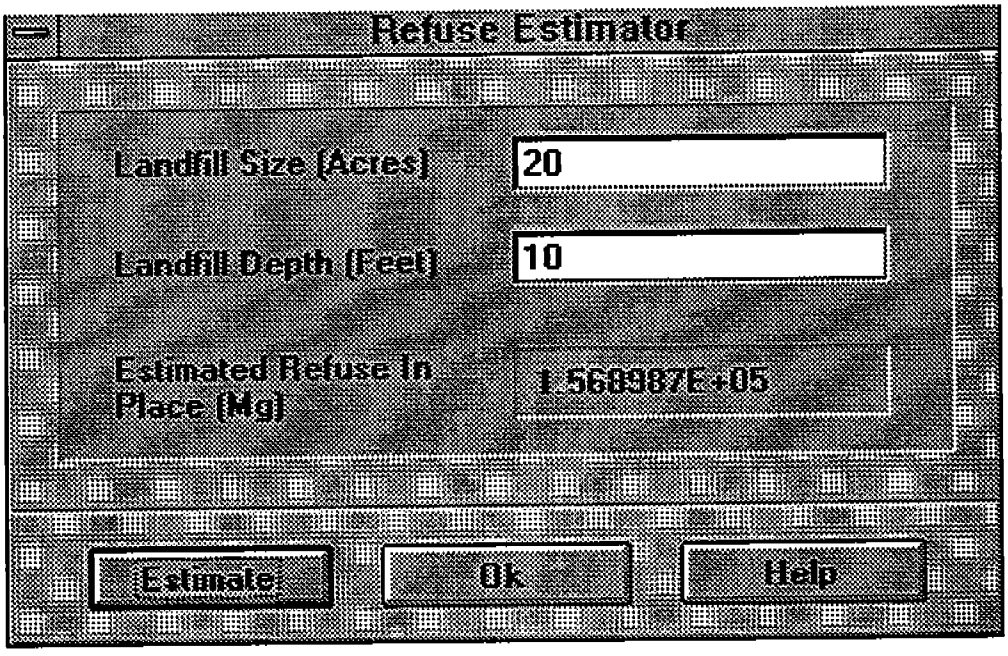

Figure 13. The Refuse Estimator utility dialog box

4.4.3 The Autocalc Function

The Autocalc function is located under the Edit menu. This function assists the user in calculating waste acceptance rate or refuse in place for the years of operation of the model. The Autocalc function is easy to use and allows the user either to enter an average acceptance rate for a period of operation or to linearly interpolate refuse data between two years. The Autocalc function works for data entered either as an acceptance rate or as refuse in place. The following examples will be used to illustrate how to use the Autocalc function.

The user should take caution: The Autocalc function does not recognize the landfill capacity as the upper limit which the refuse in place cannot exceed. It is possible to use the Autocalc function to calculate values for the acceptance rates or the refuse in place that cause the final values for the accumulated refuse to exceed the landfill capacity. If accumulated refuse exceeds the landfill capacity, the data must be erased or adjusted before a report can be generated.

Example 1: Step-wise Entry of Refuse Acceptance Rates

If the acceptance rates vary linearly over a period of years, or if the acceptance rates for a number of years are unknown and an average rate will be assumed. The Autocalc function can assist in entering step-wise acceptance rates. In this example, the user will have two periods of acceptance rates for which the Autocalc function will be used: one in which the acceptance rate will increase over time and one in which the acceptance rate will be constant for a number of years. For this example, the model will open in 1971 and the current year will be 1986.

To input an increasing refuse acceptance rate, the respective acceptance rate must be entered for the beginning and ending point. Assume that the landfill capacity is 2000 Mg, the refuse acceptance rate in the first year (1971) is 10 Mg/yr, and the refuse acceptance rate in the tenth year (1980) is 100 Mg/yr. To use the Autocalc function to interpolate between the two rates, select the waste acceptance rate for the year 1971. Click and drag the mouse until all the cells from years 1971 through 1980 are highlighted. Then, from the Edit menu, select the

Autocalc function. The computer model will linearly interpolate the acceptance rate for the years between 1971 and 1980. In this case, the rate increases from 10 Mg/yr to 100 Mg/yr in 10 Mg/yr increments.

To input a constant refuse acceptance rate, the constant acceptance rate must be entered for the beginning and end points. In this case, assume that the acceptance rate remains constant at 100 Mg/yr from 1980 through 1985. Start by entering 100 Mg/yr in the acceptance rate cell for the year 1985. Then highlight all the cells from years 1980 through 1985. From the Edit menu choose the Autocalc function. The computer model will enter the acceptance rate of 100 Mg/yr for each year between 1980 and 1985. Note that, in both cases, entering acceptance rate values with the Autocalc function caused the refuse in place data to change accordingly.

Example 2: Refuse Data Unknown for Early Periods of Operation

This example will begin with a new study. Assume that a landfill of capacity 5000 Mg opens in the year 1971 and the current year is 1980. For the last two years, the amount of refuse in place has been recorded. In 1979 the refuse in place totaled 2000 Mg, and in 1980 it was 2350 Mg. However, there are no records to indicate what the refuse in place was for 1971 through 1979. The Autocalc function can be used

The refuse in place in 1971 must be zero because 1971 is the year the landfill opened. Assuming that the acceptance rates were constant from 1971 to 1979, the Autocalc function can be used to linearly interpolate backwards to produce data between 1971 and 1979. As in the previous example, begin by selecting the cell with the earlier date. In this case, move the active cell to the refuse in place for 1971. Click and drag the mouse until all the cells between 1971 and 1979 are highlighted. Then choose the Autocalc function from the Edit menu. The values in both the refuse acceptance rate and refuse in place column will be calculated. The refuse acceptance rate for years 1971 through 1978 will be 250 Mg/yr. The refuse acceptance rate for the year 1979 will be 350 Mg/yr. The refuse in place will compound steadily through these years between the first year (0 Mg in place) and the ninth year (2000 Mg in place).

4.5 Adapting the Model for a Specific Scenario

Whenever possible, actual landfill data should be used to run the emissions estimation model. However, sometimes landfill data may be incomplete or unavailable, or a landfill owner or operator may wish to estimate the emissions for a landfill that has not yet opened. In such cases, the model can be used to forecast landfill emissions.

4.5.1 Forecasting Landfill Emissions

When forecasting emissions, it is best to use any actual data that are available. Even if a complete set of data is not available, any partial data sets should be put into the model. In cases where data are not available, the model can be used to give reasonable estimates of the landfill waste to forecast emissions.

Using the model to forecast emissions is similar to calculating past waste acceptance rates and refuse in place. The same general methodology described in the previous sections is still used: select the model parameters, identify the length of operation of the landfill, enter the refuse in place or the acceptance rates of refuse, and run a report.

The principal difference between modeling emissions for existing landfill wastes and forecasting emissions for future landfill wastes is that, instead of actual data, estimates are needed for the length of operation, landfill capacity, and landfill waste when forecasting emissions. Procedures for selecting model parameters such as the methane generation rate constant (k) or the methane generation potential (Lo) are the same for both situations, as discussed in section 4.2 (for the Windows ™ model) or section 5.4 (for the DOS model). The following paragraphs describe the modified approach to use when forecasting emissions.

Length of Operation: Specifying the length of operation of the landfill can be more complicated when forecasting emissions. If precise years of operation (e.g., 1950, 1990, 1991) are known, they can be entered for the time variables (e.g., Year Opened, the Current Year,

and the Closure Year), and the model functions normally. However, when precise dates are not known, the length of operation of the landfill can be specified with generic year numbers, such as 0001 (Year Opened), 0015 (Current Year), and 0016 (Closure Year).

Begin entering the length of time in which the landfill operates by inputting a value for the Year Opened. Then choose a value for the Current Year that allows you to input refuse data for as many years past opening as you desire. The current year is the last year for which you will be able to input refuse data into the model.

If the landfill will be open and accepting waste after the current year, then the user can choose a value for the Closure Year, or the computer model will automatically calculate it. However, if the current year is the year in which the landfill will reach its capacity, the user should either allow the computer to automatically calculate the closure year or specify a closure year value that is one year in the future of the current year (see section 4.3.3 for guidance on the Closure Year function).

Landfill Capacity: The model algorithms and validation procedures require that a design capacity be entered prior to entering yearly refuse data. That is, even for a landfill not yet in operation, the total landfill capacity must be specified before any other information about the refuse in the landfill can be entered. If necessary, the user may use the refuse estimator (see section 4.4.2) to determine the landfill capacity from estimated landfill dimensions.

Landfill Waste: For each year of operation, the amount of landfill refuse must either be entered as a refuse in place or an acceptance rate. If data are available for either refuse parameter, they should be entered into the model. For years in which no such data are available, estimates must be provided. The Autocalc Function (described in section 4.4.3) can assist the user in entering estimates for years in between those in which refuse acceptance rate or the amount of refuse in place is known.

Emissions Forecasting Examples

Two cases are illustrated below to describe the forecasting of emissions using the software model. The first scenario is a study in which partial refuse data are available; for a period of years refuse data was recorded, but for future years the refuse in place is unknown. For this example, the dates of operation are known.

The second example is less specific: no refuse data are available and no specific dates or operation are known. This example illustrates a landfill that is not yet been opened for operation. For this case, generic years of operation must be chosen.

Example 1: Partial Refuse Data and Specific Years of Operation

In this example, only partial refuse data is available for a number of years in the life of a landfill. Imagine that you need to estimate emissions for this landfill, which has a capacity of 500,000 Mg and opened in the year 1950. The current year is 1996, and in 1995 the landfill was at half capacity (i.e., 250,000 Mg). You have refuse data for each year between 1960 and the current year, but no data for any year before 1965. Your data shows that from 1960 to 1995, a constant rate of acceptance of 6,000 Mg/yr of refuse was accepted by the landfill. Imagine that you need to estimate emissions for the life of the landfill to determine applicability with MSW landfill regulations. This landfill has no codisposal and is scheduled to close in the year 2010.

To begin, enter the Year Opened (1950) in the box on the command bar (see section 4.3.1 for more information). Then enter the Current Year (1996) in the adjacent box, and input the landfill capacity specified (5.000000E+05 Mg) in the landfill Capacity box to the right. Because applicability to landfill regulations needs to be investigated, the CAA default parameters should be used. Under the Defaults menu, select the CAA item. Under the Parameters menu, be sure that No Codisposal is selected (with a check mark).

To input the Acceptance Rate data from 1960 to 1995, the Autocalc function (see section 4.4.3 for more detail) can be used to speed your entry. Move the cursor to the acceptance

rate cell for the year 1960. Input 6000 Mg/yr in the Acceptance Rate box on the command bar (see section 4.3.2 for more information on entering refuse data as acceptance rates). Move the cursor to the cell for the acceptance rate in 1995. Enter 6000 Mg/yr in this cell as well. Then highlight the all the cells between and including 1960 and 1995. Choosing the Autocalc function from the Edit menu will input a value of 6000 Mg/yr into the Acceptance Rate column for each year between 1960 and 1995.

Examining the Refuse in Place value for the year 1995 reveals that 210,000 Mg of waste had accumulated in the landfill between 1960 and 1995. However, in 1995, you know that the landfill was at half capacity. Therefore, the waste entered between 1950 and 1959 must total 250,000 - 210,000 = 40,000 Mg. For this case, we'll assume that the refuse accepted was evenly distributed between the years of 1950 and 1959.

Entering the remaining data necessary to run this scenario is also easiest with the Autocalc function. Begin by entering the waste accumulated between 1950 and 1959 (i.e., 40,000 Mg) in the Refuse in Place cell for the year 1960 (the year in which any waste accepted in 1959 would appear as accumulated waste in the landfill). The waste acceptance rate for the year 1959 will now appear to be 40,000 Mg/yr. However, this will be adjusted with the next step.

To evenly distribute the waste accepted between 1950 and 1959, highlight the Refuse in Place cells for these years. Then choose the Autocalc function from the Edit menu. The refuse data should be evenly distributed back to the year 1950 at an annual acceptance rate of 4000 Mg/yr. You should now observe as well that the Refuse in Place value for the year 1995 is now 250,000 Mg or half the landfill's capacity.

The waste acceptance rates for the remainder of the years of operation do not need to be generated with the Autocalc function. Although you could allow the software to calculate the Closure Year and the remaining waste acceptance rates automatically (see section 4.3.3 for more explanation), in this example the closure year is known. Therefore, from the Parameters

menu, select the Closure Year item. Click the User Specified diamond and enter 2010 in the adjacent box. Then choose the [OK] button. Once the closure year data has been chosen, the scenario is complete, and the study can be run by generating a report. The software model will automatically calculate the waste acceptance rates necessary to reach the landfill capacity in the specified closure year.

To examine the landfill emissions calculated by the model, a report must be generated. For this example, choose to generate, for example, a graphical report for NMOC concentration in the landfill gas. To do this, from the Report menu choose the Graphics option. When the *Select and Emitted Substance* dialog box opens, choose NMOC and click the [OK] button. A new window displaying the graphical report will open. Notice that, as was specified, the peak in the concentration graph occurs in 2010, the year in which the landfill reaches its capacity. To print this report, follow the procedures explained in section 4.6 of the user's manual.

Example 2: No Refuse Data and Generic Years of Operation

In this example, no refuse data are available and no specific dates of operation are known. Imagine that the landfill has not yet been opened, but you already know the capacity (350,000 Mg) and the number of years that the landfill will operate (50 years). For such a generic case, specific dates need not even be chosen. A Year Opened value of 1 and a Current Year value of 51 will be used. The computer will be allowed to calculate the Closure Year automatically, and it will be assumed that the waste is accepted at a uniform rate throughout the length of operation. This study will be used to estimate the actual emissions by using the AP-42 default values for k and Lo, and the landfill will be assumed to accept both hazardous and non-hazardous waste (Codisposal).

To set up the study, select the AP-42 option from the Defaults menu, and make sure that Codisposal is checked in the Landfill Type item in the Parameters menu. To begin entering the data, input the landfill Capacity (3.5000000E+05) in the cell on the command bar. Specifying the length of operation of the landfill in this case may appear slightly different than for

a "normal" landfill. Input a value of 1 in the Year Opened box and enter a value of 51 for the Current Year. Because the landfill will close the fiftieth year that it accepts waste[1] (i.e., year 51), enter a value of 350,000 Mg in the Refuse in Place cell for year 51. The waste acceptance rates during the 50 years of operation are assumed to be constant. Therefore, as in the previous example, the waste should be evenly distributed over the life of the landfill. Use the Autocalc function to input the uniform acceptance rates. Highlight the Refuse in Place cells for all years between and including 1 and 51, and then choose the Autocalc function from the Edit menu. The waste data will be changed to reflect uniform acceptance of 7000 Mg/yr for the 50 years during which the landfill accepts waste.

To generate a report for this study, follow the procedures as discussed above or as outlined in section 4.6 of this document.

4.5.2 **Compensating for Non-biodegradable Debris, Areas with Emission Controls, and Areas Outside the Radius of Influence** of Emission Controls

In certain cases, there are sections of a landfill that contain largely non-biodegradable debris (e.g., concrete, rocks, asphalt or other demolition debris) and do not produce emissions that other landfill refuse does. If records are available documenting such a quantity of waste and the regulatory agency is in agreement with this judgement, this amount of waste can be subtracted from the accumulated waste and the landfill capacity.

Similarly, when an area of the landfill is operated with a gas collection system and emission controls, this area of the landfill and the subsequent landfill waste will not release emissions at the same rate as an uncontrolled area of landfill. In the case of a landfill with such

---

[1]Although the landfill appears to operate for 51 years (i.e., year 1 through year 51), the actual operation spans only 50 years. Waste Acceptance Rates can only be entered for n-1 years (i.e., the year in which the landfill opens until the year before the accumulated waste equals the landfill's capacity). Refuse in Place data can likewise be entered for only n-1 years (the year after the landfill opens until the year in which the accumulated waste equals the landfill capacity).

emission controls, the user must estimate the quantity of the waste that is controlled and then subtract this quantity from the total amount of waste and the total capacity of the landfill. Areas outside the influence of an emission control system would still be included in the estimate of the refuse in the landfill model.

Before compensating for refuse that is assumed not to contribute to air emissions, the user should check the regulatory requirements and ensure that approval to subtract out the waste has been received from the appropriate regulatory agency. For information and guidance about the specific regulatory requirements for subtractions in emission calculations, refer to 40 CFR 60, subpart Cc and WWW, published in the Federal Register (61 FR 9905, March 12, 1996). Also refer to the draft enabling document, "Municipal Solid Waste Landfills, Volume 1: Summary of the Requirements, for the New Source Performance Standards and Emission Guidelines for Municipal Solid Waste Landfills," EPA-453/R-96-004 (MSW Landfills, Volume 1). The document has been posted on the EPA Technology Transfer Network (TTN) electronic bulletin board, and explains landfills NSPS and Emission Guideline control, monitoring, record keeping and reporting requirements.

4.6 Generating and Printing Reports

Once you have set the operating conditions of the landfill and the default parameters for the formulas calculating the landfill gas production rate, emissions can be calculated and displayed for the landfill study. The emissions can be reported either as a table or as a graph of emissions over the life of the landfill. The program will report emissions of one pollutant at a time. Different pollutants can be displayed on the screen at the same time, however, in different windows. The data in the program can be printed only through a report.

4.6.1 Tabular Reports:

1. Select the Reports menu.
2. Select Text . . .

A Select Emitted Substance dialog box will appear (Figure 14).which lists all the pollutants for which the program will calculate emissions. The toxic air pollutants and the concentrations assumed in the landfill gas are affected by the system default options you have selected previously.

3. Select a pollutant to report. For example, select Benzene.

4. Select [OK]. (If you wish to exit the Select Emitted Substance dialog box without selecting a pollutant, select [Cancel].)

A document window will appear containing the textual report (Figure 15). The report lists the parameters of the model that you have selected, including the values for Lo, k, and NMOC concentration, the methane concentration (ppmv), the carbon dioxide concentration, and the selected air parameter (with its molecular weight and concentration in parts per million by volume, given the selected program options). In addition, the report lists the operating parameters of the landfill, including the year opened, the current year, the year of closure, the capacity of the landfill, and the average acceptance rate that can be accommodated from the current year to the year of closure.

Then the report lists the refuse in place and the emissions, in Mg/yr and in cubic m/yr, for each year the landfill was open and for whatever number of years after closure you have specified in the Options item under the File menu.

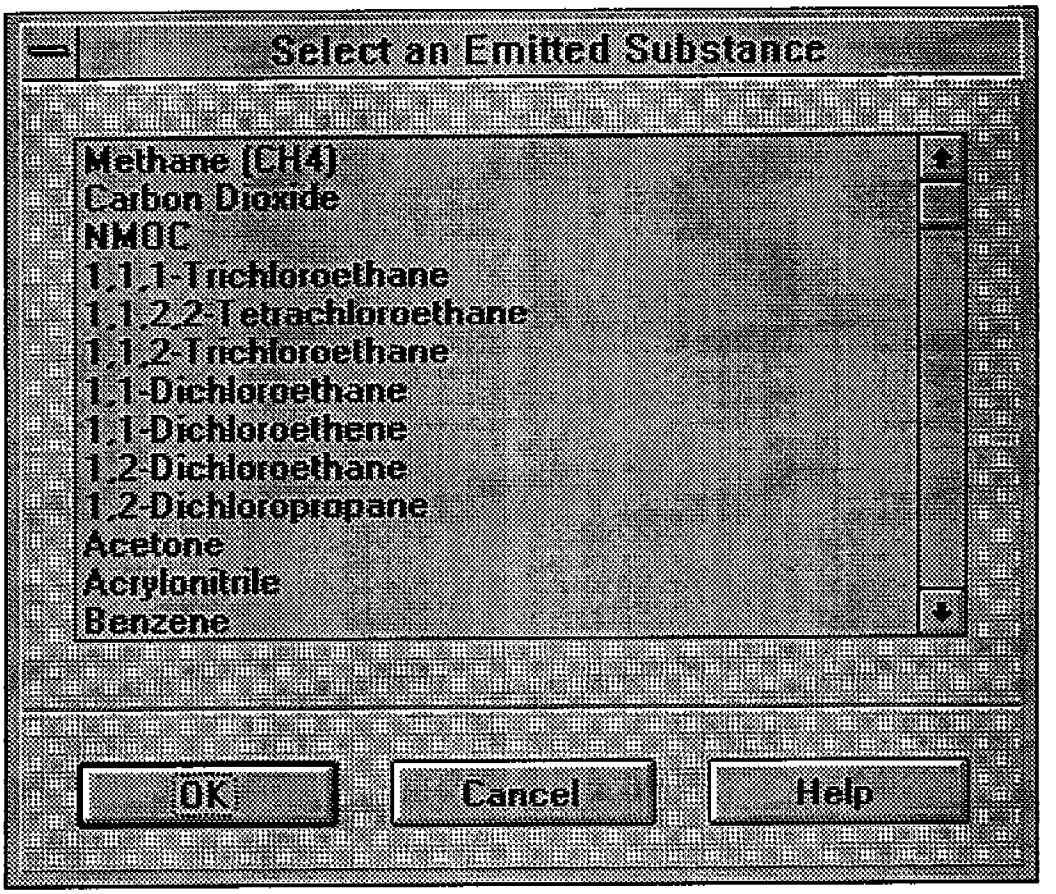

Figure 14. Dialog box for selecting a pollutant for which to estimate emissions

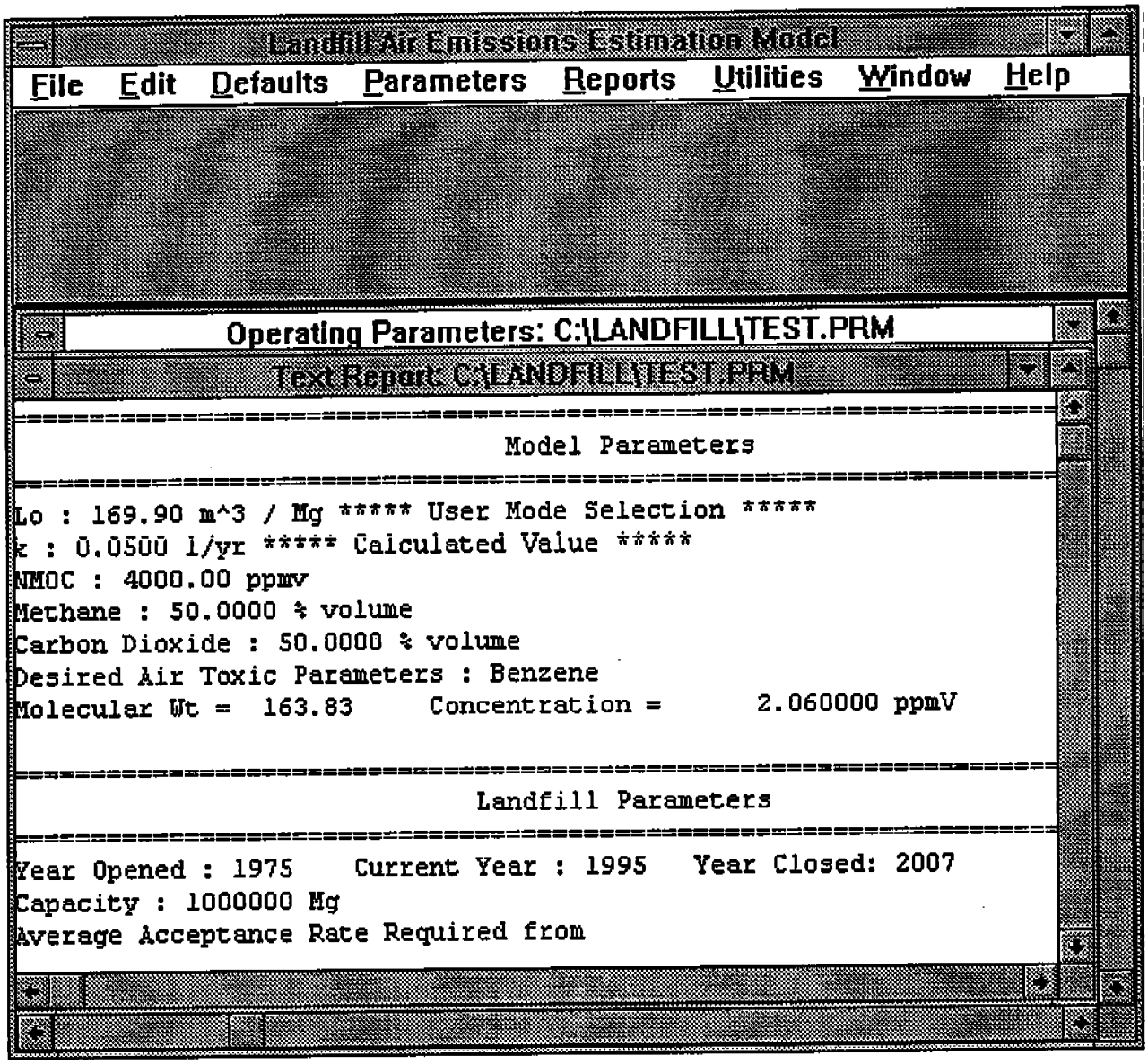

Figure 15. Document window containing an emission report for benzene

652-015-59-02\Landfil3\tom
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4.6.2 Graphical Reports:

1. Select the Reports menu.

2. Select Graphics ...

A Select an Emitted Substance dialog box will appear (see Figure 14), which lists all the pollutants for which the program will calculate emissions. The toxic air pollutants and the concentrations assumed in the landfill gas are affected by the system default options you have selected previously.

3. Select a pollutant to report. For example, select Benzene.

4. Select [OK]. (If you wish to exit the Select an Emitted Substance dialog box without selecting a pollutant, select [Cancel].)

   A Graphics document window will appear containing the graph of projected emissions (in Mg) for the selected pollutant (Benzene) over the life of the landfill and the number of years specified after landfill closure.

4.6.3 Setting Up the Printer

To set up the printer:

You must use the Microsoft Windows Control Panel to install or change printers.

To install a printer:

1. Open the Windows Control Panel.

2. Double-click on the Printers icon.

3. Select [Add] for a list of available printer drivers.

4. Scroll down the list to find the name of your printer.

5. Select the printer by clicking on its name in the list.

6. Select [Install...]. If the printer driver is not installed, a dialog box will appear for installing the printer driver.

If the printer driver is already installed, the printer will become the default printer.

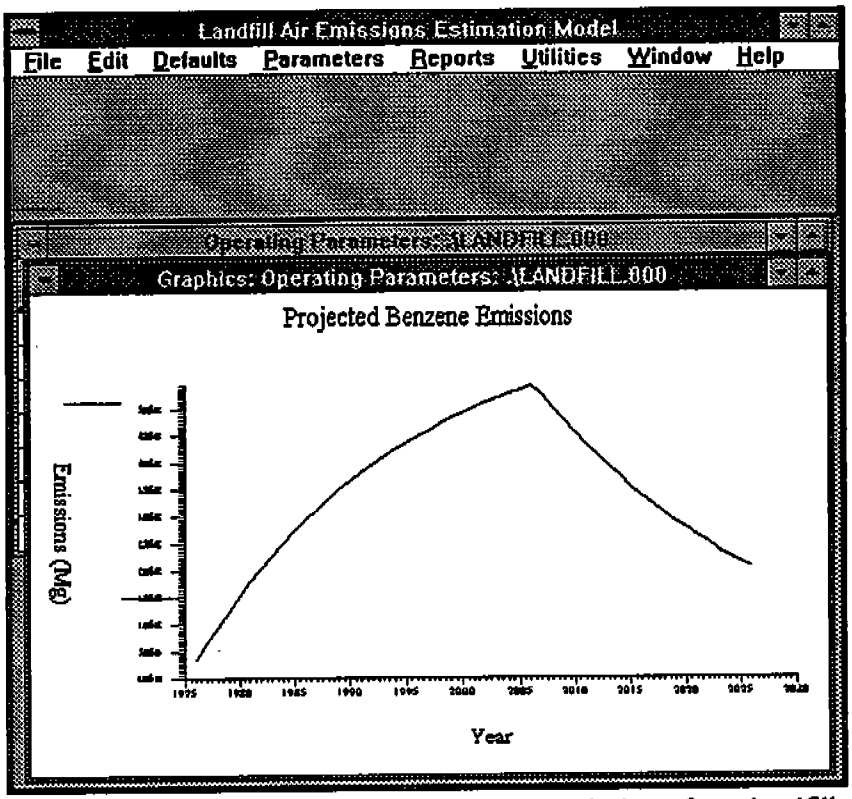

Figure 16. A graph of projected benzene emissions for a landfill.

You can print only emission reports. The print command will not have any effect if only the landfill study window is open. To get access to the print command, first select the Reports menu and either a text or a graphics report (see section 4.6.1 or 4.6.2).

4.6.4 Formatting and Printing Reports

Formatting a report:

To format a report, select the Print command from the File menu. After selecting the Print command, a dialog box will appear with two format options buttons: [Setup] and [Select Font]. Selecting the [Setup] button will access the print driver, which is not specific to

this program. Choosing the [Select Font] command will allow you to change the text characteristics in the printed report.

To change the font or font size, select [Select Font]. A dialog box will open with a list of fonts on the left and a list of font sizes on the right. Select a different font or font size to change the format of the report. However, the user should be cautioned. The default font size is 32-point; the 32-point font size will appear equivalent to 10-point font in a conventional report printout. Choose a larger font size to enlarge the text or choose a smaller font size to make the text smaller on the page. After finishing making changes to the font, the user should select the [OK] button to return to the original print dialog box.

Printing a report:

Printing is accessed through the File menu. The Print command will not function unless a report is open, and the printout will contain the file name of the open file. To print the report:

1. Select the File menu.
2. Select Print. You must have a report open, either a graphics report or a text report, to be able to print.
   If you have a report open, a dialog box will come up for printing, listing the available printers (Figure 17).
3. Select [Print] in the Print dialog box to print the report to the listed printer (see Figure 17).
4. Exit the report by double clicking the close button in the upper left corner of the Report Window.

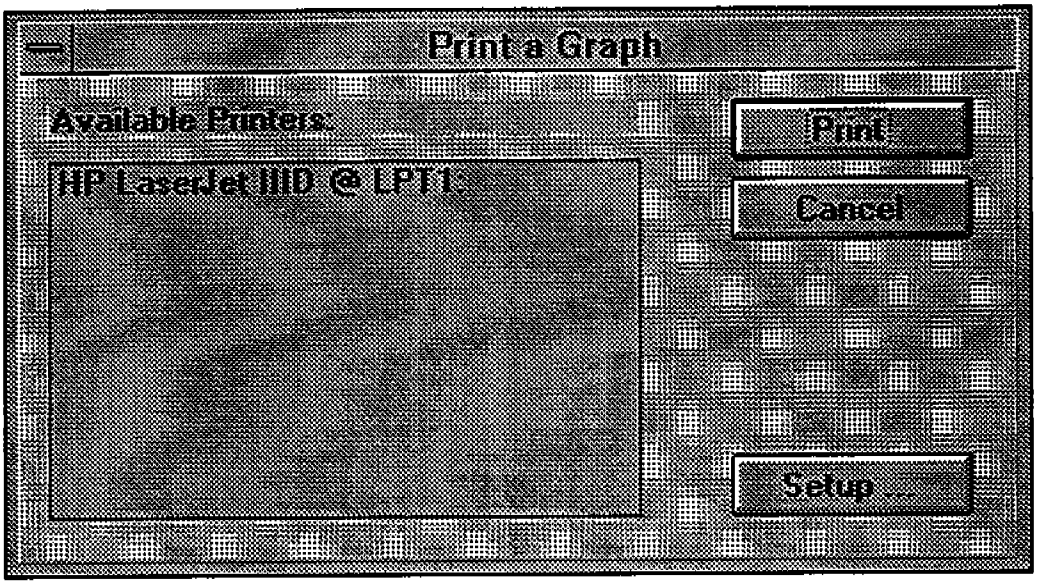

Figure 17. Dialog box for printing a graph

4.7 Saving a New or Existing Landfill Study

With the Save As command, you can save a document under a new name, in a different directory, or on another disk. Note that if a document has never been saved before, choosing either the Save As or Save command from the File menu displays the dialog box where you can specify a name for the document file. The filename can be a maximum of eight characters plus an extension of up to three characters. The filename and extension are separated by a period. The program automatically appends an extension to a document if you do not type an extension when you save the document. Landfill studies are saved automatically with a .PRM file extension.

To save a new or existing document as a new document file:

1. From the File menu, select Save As.

2. If you want to save the document under a name different from the one proposed, type the name for the document.

In the dialog box, you can also select a different drive and a different directory in which to save the document. Or you can type the complete path and filename (Figure 18).

3. Select [OK] to save the document.

To save an existing document quickly under the same name:

1. Select Save from the File menu.

   The program replaces the previously saved version of the document with the current version, in the same directory, under the same name.

If you attempt to exit the program before saving a study, you will be prompted for confirmation to exit without saving.

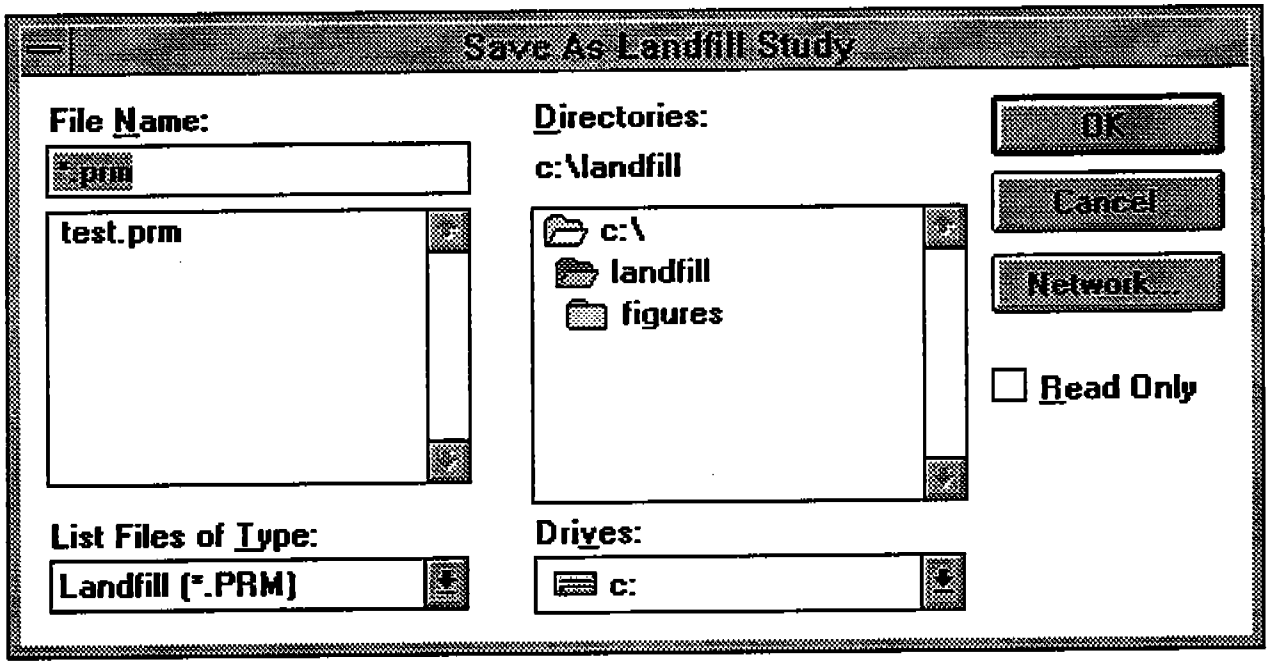

Figure 18. Dialog box for saving a landfill study

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5.0 ESTIMATING LANDFILL EMISSIONS USING THE DOS MODEL

5.1 Menus

The DOS version of the Landfill Air Emissions Estimation program uses bar menus, which appear in the center of the computer display, to control the actions of the program. You may select an entry from the menu by using the cursor motion keys ([↑] and [↓]) to highlight the desired entry and pressing [ENTER]. After an entry has been selected, the program will either perform some action or present another menu of options (a sub-menu). To exit a sub-menu and return to the previous menu, press [ESC].

Once the program has been activated, the system will display an introductory message as shown in Figure 19 and will pause until the user presses any key. The program will display the main menu of choices available. The Main Menu is shown in Figure 20. This discussion of the DOS model is organized by the menu selection. The selections available in the Main Menu are described in Table 3.

Table 3. Main Menu for the DOS Program

Command	Description
Specify Study*	Designates a study name to revise or create.
Edit Study Data	Edits model parameters and operational data.
Calculate Air Emissions	Calculates the air emissions estimates.
Display Results	Prints the report of the emission estimates.
Configure Program	Designates the working directory for saving study files, the printer, and the set of program default values.
Exit	Exits the program and returns to DOS.

* A study name must be specified before any other function can be performed.

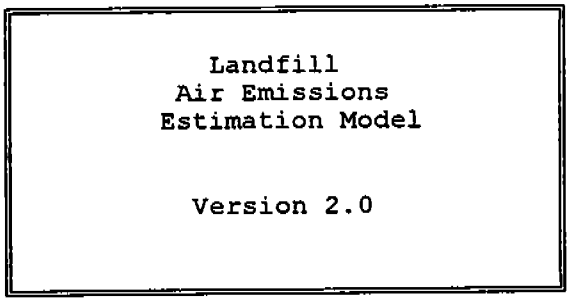


Figure 19. Introductory screen

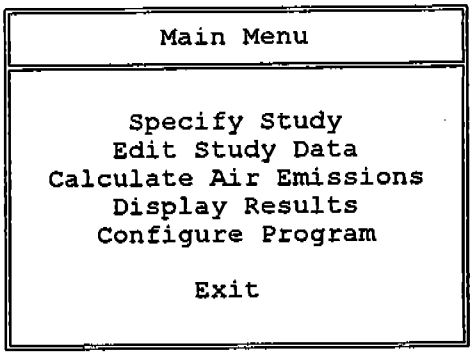


Figure 20. Main Menu

5.2 Help

Help is available for most of the menus and data entry screens in the DOS model. To view the help available for a given menu, press the [F1] key. The help screen will display all the available information concerning that menu or data entry screen. Help may contain several screens of information for any screen. The small arrows in the left margin of the help screens indicate that only part of the help information appears on the screen. To scroll through the screens, use the cursor motion keys ([↑] and [↓]). In addition to the information in the full help screens, the function keys are defined at the bottom of each menu or data entry form.

5.3 Specify Study

Selecting Specify Study from the Main Menu brings up the Specify Study Type sub-menu (Figure 21), which lets the user choose between either naming a new study to create or recalling an old study to update. Upon selecting a new study or old study, one of the study name entry screens displayed in Figure 22 will appear. The old studies on file can be listed by pressing [F2] (Figure 23). A study can be selected from the listing of studies on file by using the cursor motion keys ([↑] and [↓]) and then pressing [ENTER] to enable the study. The user may create a new study by typing the desired name in the Specify New Study Name entry screen. Press [ENTER] to return to the Main Menu. A study name can be up to eight characters long.

5.4 Edit Study Data

Selecting Edit Study Data from the Main Menu brings up the Edit Study Data sub-menu (Figure 24). The selections in Table 4 are available in this sub-menu:

Table 4. Edit Study Data Sub-Menu

Command	Description
Chemical Composition	Defines the composition of the landfill gas.
Methane Rate Constant (k)	Defines the constant used by the program for the methane (landfill gas) generation decay rate.
Methane Potential (Lo)	Defines the constant used by the program for the methane (landfill gas) generation potential.
Operational Data	Defines the landfill operational data.

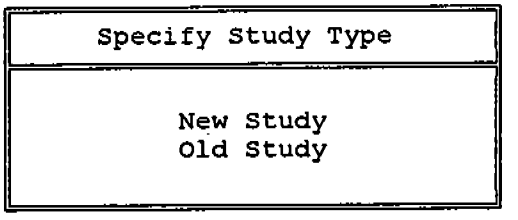
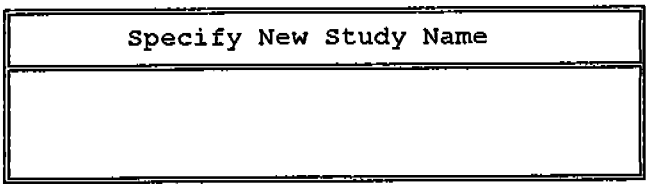


Figure 21. Specify Study Type sub-menu



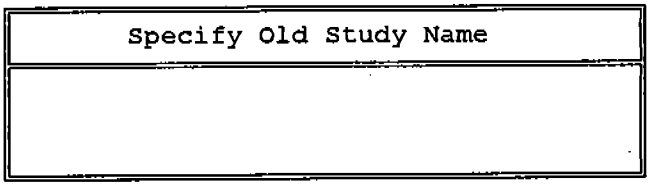


Figure 22. Specify Study Name entry screens

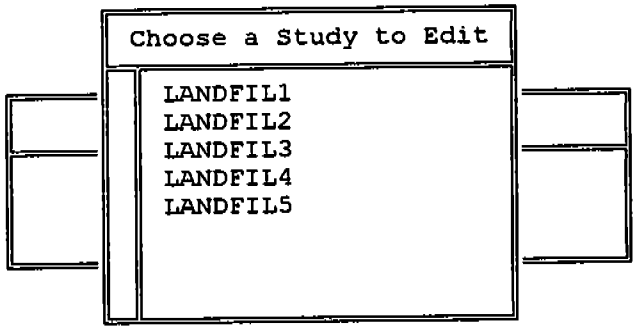


Figure 23. Choose a Study to Edit window

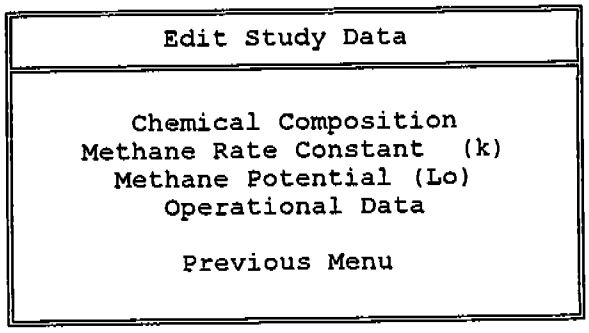


Figure 24. Edit Study Data sub-menu

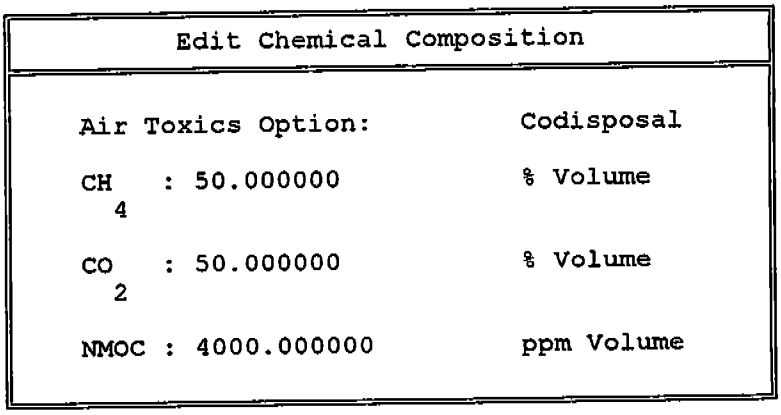


Figure 25. Edit Chemical Composition data entry screen

5.4.1 Chemical Composition

Landfill gas is generated from the anaerobic decomposition of refuse in municipal solid waste landfills. The gas composition is typically about 50 percent methane (CH_4) and 50 percent carbon dioxide (CO_2) with trace amounts of NMOC and toxic air pollutant species.

Selecting Chemical Composition from the Edit Study Data sub-menu displays the landfill gas Chemical Composition data entry form (Figure 25), Data entry screens are used in this program to obtain input values from the user. A data entry screen consists of several data entry fields, each of which accepts a specific piece of information. Select a different field by using the cursor motion keys ([↑] and [↓]) to highlight the desired field. Any default value displayed in the field may be overwritten. Once the desired value has been entered, simply press [ENTER] to proceed to the next field. At any point during data entry in the Chemical Composition data entry screen, the highlighted field may be returned to its default value by pressing [F2].

The Chemical Composition data entry form has a toggle switch for toxic air pollutants hazardous waste codisposal, and entry fields for NMOC, CH_4 and CO_2. The default composition for CH_4 and CO_2 is 50 percent each. A different concentration for CH_4 may be entered by the user. The corresponding concentration of CO_2 will automatically be calculated assuming that CO_2 is the remainder of the landfill gas.

Toxic Air Pollutants

The space bar toggles the Air Pollutant Option in the Chemical Composition data entry screen among three choices: codisposal, no codisposal, and none. "Codisposal" means that the landfill was used for hazardous waste. "No codisposal" means that the landfill was never used for hazardous waste. "None" means no concentrations of air pollutants will be included in the emission analysis. Choosing codisposal affects both the default concentrations of air pollutants

and the default concentrations of NMOC. If it is unknown whether the landfill has ever been used for hazardous waste, select the worst case option, which is codisposal.

After the desired values have been selected from the Chemical Composition data entry screen, press [F10] to accept the data. If toxic air pollutants are to be included in the study, then upon accepting the data, the data entry screen shown in Figure 26 will appear, with the list of toxic air pollutants and their default concentrations in the landfill gas. These data were collected from test data compiled for AP-42 (EPA, 1994). Again, the default concentrations can be overwritten. Toxic air pollutants can be added or deleted from this list by pressing [F5] or [F6], respectively. The default toxic air pollutants and their concentrations can be retrieved by pressing [F2]. The caution shown in Figure 27 will appear before the default toxic air pollutants and the default concentrations are retrieved. The user can press [ESC] to retain the data as edited or any key to continue to reset the data to default values. As in other data entry screens, press [F10] to accept the data.

Air pollutants may be added permanently to the default list of 39 toxic air pollutants by editing the file AIRTOXIC.TXT with a text editor or a word processor in non-document mode. The system will track 60 toxic air pollutants. The format for entering data into this file is shown in Table 2 (see section 4.3.2). The format consists of 30 characters for the chemical name, 10 digits for molecular weight, 9 digits for the concentration with no codisposal, and 9 digits for the concentration with codisposal. To enter data for a new pollutant into AIRTOXIC.TXT, use the DOS text editor. For example, if you were to enter data for ethyl mercaptan, with a molecular weight of 62.13 and a concentration of 0.86, open the text editor in DOS; at the C:\> prompt, type EDIT C:\LANDFILL\AIRTOXIC.TXT. The text editor will open AIRTOXIC.TXT. Using the cursor motion keys (the arrow keys), move to the place in the alphabetical list where ethyl mercaptan belongs. Press [ENTER] to create a space. Type in ETHYL MERCAPTAN. Press the spacebar or arrow space keys to move the cursor to the molecular weight column. Type in 62.13. Move the cursor to the last column. Type in 0.86 for concentration with codisposal. Save the file.

Edit Air Pollutant Concentration			
Chemical	Molecular Weight	Concentration (ppmv) No Codisposal	Codisposal
1,1,1-Trichloroethane	133.41	0.2700	0.2700
1,1,2,2-Tetrachloroethane	133.41	0.2000	0.2000
1,1,2-Trichloroethane	133.41	0.1000	0.1000
1,1-Dichloroethane	98.96	2.0700	2.0700
1,1-Dichloroethene	96.94	0.2200	0.2200
1,2-Dichloroethane	98.96	0.7900	0.7900
1,2-Dichloropropane	112.99	0.1700	0.1700
Acetone	58.08	6.8900	6.8900
Acrylonitrile	53.06	7.5600	7.5600
Benzene	78.12	0.3700	24.9900

Figure 26. Edit Air Pollutant Concentration entry screen

CAUTION
The action you are taking will reset the ENTIRE air toxics list to its default state.

Figure 27. Caution screen

NMOC

The system supplies default values for NMOC concentrations, depending on whether you are using regulatory or AP-42 defaults and whether the landfill has hazardous waste codisposal or not. The default values for NMOC are:

- Regulatory defaults: 4000 ppmv
- AP-42 defaults: 2420 ppmV for codisposal landfills
  595 ppmv for no codisposal landfills

Site specific data for NMOC concentrations can be entered instead of these values in the Edit Chemical Composition data entry screen.

5.4.2 Methane Generation Rate Constant

This selection causes the Edit Methane Generation Decay Rate Constant sub-menu to appear as shown in Figure 28. This screen allows for the selection of the following three methods for setting the methane generation rate constant:

- Use Default Value of k;
- Supply a Value of k; and
- Calculate a Value of k.

Choosing the first option allows the use of two default k values, depending on the system default option in effect (chosen in Configure Program/Defaults Mode): the k value is 0.05 1/yr for the regulatory system default option and 0.04 1/yr for the AP-42 (inventory) system default option. Further information about the default k values is provided in the background information document for the federal landfill regulations (EPA, 1991b), as well as memoranda in Public Docket A-88-09 (McGuinn, 1988a and 1988b). To enter an alternative decay rate constant,

choose the option to supply a value of k. The Methane Generation Rate Constant data entry screen appears (Figure 29).

Choosing the third option to calculate a value of k branches to a data entry screen allowing the entry of parameters specific to testing procedures in draft CFR Method 2E (EPA, 1991a). A screen will appear informing the user that CFR Method 2E or comparable testing must have been performed in order to calculate a k value (Figure 30). If the option to calculate a value of k is chosen, the Calculate Methane Gas Generation Constant data entry screen (Figure 31) will be displayed. All of the parameters must be non-zero in order for a value of k to be calculated. A value of k will appear when all parameters are non-zero. The calculated value of k can be changed simply by changing one of the input parameters and pressing [ENTER]. The default values may be overwritten. Press [F10] to accept the calculated value of k.

5.4.3 Methane Generation Potential

Selecting Methane Potential in the Edit Study Data Menu allows the user to input a methane generation potential constant (Lo). The default values for Lo depend on the system default option in effect: Lo defaults to 6000 ft^3 CH_4/Mg of refuse for the regulatory system default option and to 4411 ft^3 CH_4/Mg of refuse for the AP-42 system default option. The default values of 6000 or 4411 ft^3 CH_4/Mg of refuse may be overwritten. Press [F10] to accept the chosen value. The data entry screen for the Methane Generation Potential Constant is shown in Figure 32.

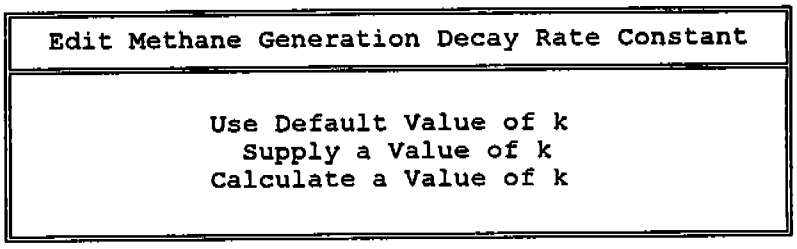


Figure 28. Edit Methane Generation Decay Rate Constant sub-menu

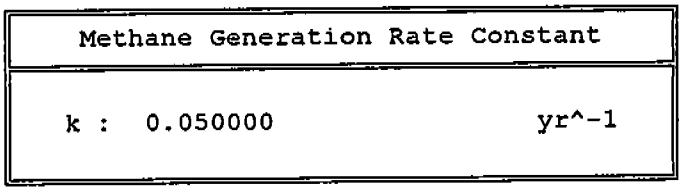


Figure 29. Methane Generation Rate Constant data entry screen

To calculate a k value, you must have performed the field tests as outlined in proposed EPA Method 2E. Press ESCAPE to return to the previous menu.

Figure 30. CFR Method 2E caution screen

Calculate Methane Gas Generation Constant		
Average Well Depth	0.000000	ft
Average Stabilized Radius of Influence	0.000000	ft
Refuse Density	0.650000	Mg/ft^3
Fraction of Decomposable Refuse	1.000000	
Methane Generation Potential	6000.000000	ft^3/Mg
Average Stabilized Flow Rate per Well (Lo)	0.000000	ft^3/min
Average Age of Refuse	0.000000	yr
Calculated Value of k	0.050000	yr^-1

Figure 31. Calculate Methane Gas Generation Constant data entry screen

5.4.4 Operational Data

Selecting Operational Data in the Edit Study Data Menu causes the Edit Refuse Data Periods data entry screen, presented in Figure 33, to appear. This data entry screen allows the user to enter the landfill operational parameters and the history of the landfill.

Year Opened/Current Year

Upon activation of the data entry screen, the user is permitted to change the year the landfill opened and the current year. For a new study, the default current year is determined from the computer system clock and the opening year defaults to 10 years before that year. Both of these parameters can be changed by the user.

Design Capacity

Upon keying the year opened and the current year into the entry screen, the design capacity of the landfill may then be entered. For a new study the maximum capacity of the landfill is initialized to zero, and a value must be entered before proceeding further. The value in place for an old study may be changed in order update the study. After accepting this information by pressing [F10] or [ENTER], the operational parameters are verified for appropriateness. The design capacity of the landfill cannot be zero and the operating life of the landfill must be less than the computer program memory limitation of 300 years.

5.4.5 Refuse in Place

After successful validation of the landfill operating parameters, the user will be permitted to enter the landfill history consisting of yearly total refuse in place information for the years of operation. The list of years may be scrolled up or down using the cursor motion keys

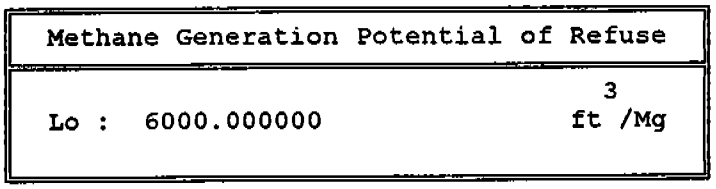


Figure 32. Methane Generation Capacity data entry screen

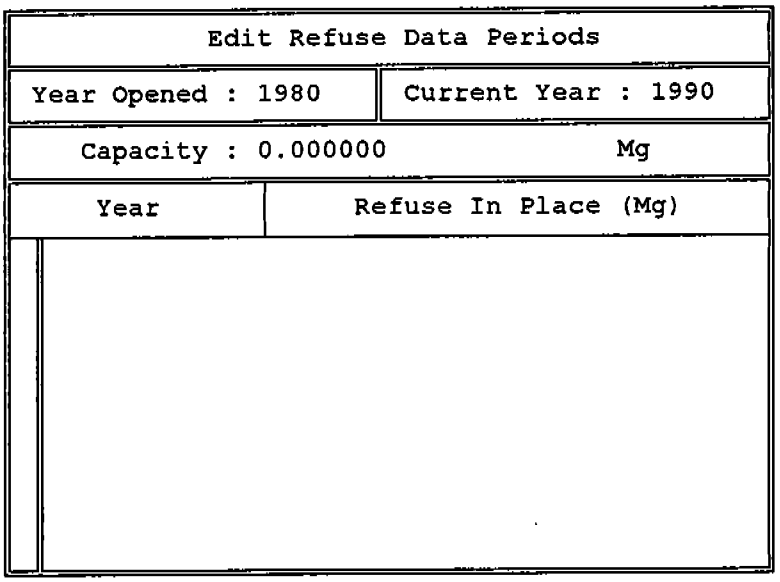


Figure 33. Edit Refuse Data Periods data entry screen

([↑], [↓], [PAGE UP], or [PAGE DOWN]). Initially, all data are set at zero. The user should enter the refuse in place for all years known. The [↑] key can be used to go back to and correct previously entered values. If any value is zero (except the current year, which cannot be zero), the program will interpolate a refuse in place value using surrounding values after the list is accepted. The last value entered does not require [ENTER] to be pressed for it to be accepted. Instead, press [F10] to accept all values. The list of refuse in place values may be returned to its all-zero state by pressing [F2].

After accepting the history data by pressing [F10], the data will be verified for validity. Successive years cannot be less than the previous years (except in the zero case, which indicates unknown data), and the total refuse in place must always be less than or equal to the design capacity of the landfill.

5.4.6 Predicted Closure Year

Successful entry of the operational data will cause the program to determine refuse in place for all years listed as zero. The program then determines the acceptance rate for the last one-year period entered in the history list and uses this rate to project the closure year (Figure 34). If the landfill has not reached the design capacity, the user will be given the choice of either accepting or altering the calculated year of closure. If the landfill has already reached capacity, the user will not be permitted to change the closure year.

If the year of closure is changed and accepted by pressing either [F10] or [ENTER], the program will verify that the period of operation of the landfill is less than the program limitation of 300 years. If the closure year is valid, the program will recalculate the refuse acceptance rate necessary to reach design capacity by the entered year of closure. Operational data must be entered for each new study in order for calculations to take place. If no other data are entered into the model, default parameters will be used in the calculations. Once

the operational data have been entered and accepted by the program, the Edit Study Data Menu will reappear.

If all of the study data have been entered, simply select the Previous Menu option to return to the Main Menu.

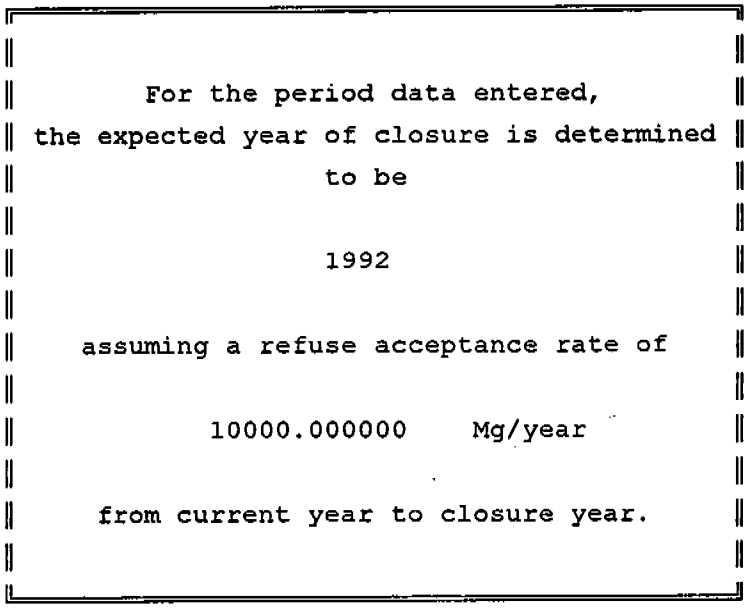


Figure 34. Closure periods screen

5.5 Adapting the Model for a Specific Scenario

Whenever possible, actual landfill data should be used to run the emissions estimation model. However, sometimes landfill data may be incomplete or unavailable, or a landfill owner or operator may wish to estimate the emissions for a landfill that has not yet opened. In such cases, the model can be used to forecast landfill emissions.

5.5.1 Forecasting Landfill Emissions

When forecasting emissions, it is best to use any actual data that are available. Even if a complete set of data is not available, any partial data should be put into the model. In cases where no or partial data are available, reasonable estimates of the landfill waste are needed to forecast emissions.

Using the model to forecast emissions is similar to calculating past waste acceptance rates and refuse in place. The same general methodology described in the previous sections is still used: select the model parameters, identify the length of operation of the landfill, enter the refuse in place or the acceptance rates of refuse, and run a report.

The principal difference between modeling emissions for existing landfill wastes and forecasting emissions for future landfill wastes is that, instead of actual data, estimates are needed for the length of operation, landfill capacity, and landfill waste when forecasting emissions. Procedures for selecting model parameters such as the methane generation rate constant (k) or the methane generation potential (Lo) are the same for both situations, as discussed in section 4.2 (for the Windows ™ model) or Section 5.4 (for the DOS model). The following paragraphs describe the modified approach to use when forecasting emissions.

Length of Operation: Specifying the length of operation of the landfill can be more complicated when forecasting emissions. If precise years of operation (e.g., 1950 and 1990) are known, they can be entered for the time variables (e.g., Year Opened and the Current Year), and the model functions normally. However, when precise dates are not known, the length of operation of the landfill can be specified with generic year numbers, such as 0001 (Year Opened) and 0015 (Current Year).

Begin entering the length of time in which the landfill operates by inputting a value for the Year Opened. Then choose a value for the Current Year that allows you to input refuse

data for as many years past opening as you desire. The current year is the last year for which you will be able to input refuse data into the model.

Landfill Capacity: The model algorithms and validation procedures require that a design capacity be entered prior to entering yearly refuse data. That is, even for a landfill not yet in operation, the total landfill capacity must be specified before any other information about the refuse in the landfill can be entered.

Landfill Waste: For each year of operation, the amount of landfill refuse must either be entered as a refuse in place or an acceptance rate. If data are available for either refuse parameter, they should be entered into the model. For years in which no such data are available, estimates must be provided.

Emissions Forecasting Examples

Two cases are illustrated below to describe the forecasting of emissions using the software model. The first scenario is a study in which partial refuse data are available; for a period of years refuse data was recorded, but for future years the refuse in place is unknown. For this example, the dates of operation are known.

The second example is less specific: no refuse data are available and no specific dates or operation are known. This example illustrates a landfill that is not yet been opened for operation. For this case, generic years of operation must be chosen.

Example 1: Partial Refuse Data and Specific Years of Operation

In this example, only partial refuse data is available for a number of years in the life of a landfill. Imagine that you need to estimate emissions for this landfill, which has a capacity of 500,000 Mg and opened in the year 1950. The current year is 1996, and in 1995 the landfill was full to half its capacity (i.e., 250,000 Mg). You have refuse data for each year between 1965 and the current year, but no data for any year before 1965. Your data shows that from 1965 to 1995,

a constant rate of acceptance of 6,000 Mg/yr of refuse was accepted by the landfill. Imagine that you need to estimate emissions for the life of the landfill to determine applicability with MSW landfill regulations. This landfill is scheduled to close in the year 2010.

Because applicability to landfill regulations needs to be investigated, the Regulatory default parameters should be used (selected in the Defaults Mode item under the Configure Program item in the main menu). To begin entering data, choose to Edit Study Data and then select Operational Data. Enter the Year Opened (1950) in the highlighted box. Then enter the Current Year (1996) in the adjacent box, and input the landfill capacity specified (500,000 Mg) in the landfill Capacity box below.

Examining the acceptance rate data from 1960 to 1995 shows that, at an annual acceptance rate of 6000 Mg/yr, 210,000 Mg of waste will accumulate by the year 1995. Because you know that 250,000 Mg of waste are present in the landfill in the year 1995, 250,000 - 210,000 = 40,000 Mg of waste must have been accepted between the years of 1950 and 1959. Assuming that this waste was accepted at a uniform rate, the annual acceptance of refuse must have been 4000 Mg/yr.

The DOS version of the Landfill Air Emissions Estimation Model does not allow the user to enter acceptance rates. Refuse data must be entered as the annual Refuse in Place in the landfill as of January 1 of each year. Therefore, starting with 1951 (the year in which refuse from 1950 accumulates in the landfill), begin compounding waste at 4000 Mg/yr through year 1960 (the year in which waste from 1959 accumulates in the landfill). That is, enter 4000 for 1951, 8000 for 1952, 12,000 for 1953, and so on so that the total in 1960 is 40,000 Mg. Beginning in the year 1961, increment the Refuse in Place by 6000 Mg/yr to reflect the change in the annual acceptance rate. Therefore, in 1961, the total waste in the landfill would equal 46,000; in 1962, the total would be 52,000. Continue incrementing at a rate of 6000 Mg/yr until 1995, when the total will be 250,000 Mg.

The Refuse in Place data for the remainder of the years of operation (i.e., until 2010) do not need to be entered into the model. Although you could allow the software to calculate the Closure Year and the remaining Refuse in Place data automatically (see section 5.4.6 for more explanation), in this example the closure year is known. Therefore, after all the refuse in place data has been entered and accepted (by pressing the F10 key), choose to change the Closure Year from the computer calculated value (2037) to 2010. The software model will automatically calculate the waste acceptance rates necessary to reach the landfill capacity in the specified closure year.

To examine the landfill emissions calculated by the model, a report must be generated. For this example, choose to generate, say, a graphical report for NMOC concentration in the landfill gas. After selecting Calculate Results from the main menu, choose to Display Results as an On-screen Graphic for NMOC. A new screen displaying the graphical report will open. Notice that, as was specified, the peak in the concentration graph occurs in 2010, the year in which the landfill reaches its capacity. To print this report, follow the procedures explained in section 5.9 of the user's manual.

Example 2: No Refuse Data and Generic Years of Operation

In this example, no refuse data are available and no specific dates of operation are known. Imagine that the landfill has not yet been opened, but you already know the capacity (350,000 Mg) and the number of years that the landfill will operate (50 years). For such a generic case, specific dates need not even be chosen. A Year Opened value of 1 and a Current Year value of 51 will be used. The computer will be allowed to calculate the Closure Year automatically, and it will be assumed that the waste is accepted at a uniform rate throughout the length of operation. This study will be used to estimate the actual emissions by using the AP-42 default values for k and Lo.

To set up the study, select the AP-42 option in the Defaults Mode item under the Configure Program menu. Then specify the length of operation of the landfill. In this case,

choosing the years of operation may appear slightly different than for a "normal" landfill. Input a value of 1 in the Year Opened box and enter a value of 51 for the Current Year. To begin entering the refuse data, input the landfill Capacity (350,000) in the cell on the command bar. To simplify this example, the waste acceptance rates during the 50 years of operation are assumed to be constant. Therefore, as in the previous example, the waste should be evenly distributed over the life of the landfill, and the annual acceptance rate should be 7000 Mg/yr. Begin entering Refuse in Place data starting with year 2 (the year in which data from year 1 accumulates). In year 2, the amount of Refuse in place should be 7000 Mg. For year 3, it is 14,000 Mg. In year 4, the total is 21,000 Mg. Continue incrementing the waste until Year 51, when the total waste in the landfill is 350,000 Mg.

To generate a report for this study, follow the procedures as discussed above or as outlined in section 5.8 and 5.9 of this document.

5.5.2 Compensating for Non-biodegradable Debris, Areas with Emission Controls, and Areas Outside the Radius of Influence of Emission Controls

In certain cases, there are sections of a landfill that contain largely non-biodegradable debris (e.g., concrete, rocks, asphalt or other demolition debris) and do not produce emissions that other landfill refuse does. If records are available documenting such a quantity of waste and the regulatory agency is in agreement with this judgement, this amount of waste can be subtracted from the accumulated waste and the landfill capacity.

Similarly, when an area of the landfill is operated with a gas collection system and emission controls, this area of the landfill and the subsequent landfill waste will not release emissions at the same rate as an uncontrolled area of landfill. In the case of a landfill with such emission controls, the user must estimate the quantity of the waste that is controlled and then subtract this quantity from the total amount of waste and the total capacity of the landfill. Areas outside the influence of an emission control system would still be included in the estimate of the refuse in the landfill model.

Before compensating for refuse that is assumed to not contribute to air emissions, the user should check the regulatory requirements and ensure that approval to subtract out the waste has been received from the appropriate regulatory agency. For information and guidance about the specific regulatory requirements for subtractions in emission calculations, refer to 40 CFR 60, subpart Cc and WWW, published in the Federal Register (61 FR 9905, March 12, 1996). Also refer to the draft enabling document, "Municipal Solid Waste Landfills, Volume 1: Summary of the Requirements, for the New Source Performance Standards and Emission Guidelines for Municipal Solid Waste Landfills," EPA-453/R-96-004 (MSW Landfills, Volume 1). The document has been posted on the EPA Technology Transfer Network (TTN) electronic bulletin board, and explains landfills NSPS and Emission Guideline control, monitoring, record keeping and reporting requirements.

5.6 Configure Program

The Configure Program option from the Main Menu allows the user to select the working directory for the program, the default print device, the years past closure of the landfill for which the program will calculate emissions, and two system default modes: AP-42 (defaults for doing emission inventories) and regulatory (defaults related to the federal guidelines for air emissions from municipal solid waste landfills). The Edit System Configuration screen is shown in Figure 43.

The working directory is the directory from which all study files are loaded and into which study parameters are saved. The Default Print Device is the printer to which reports can be sent. There are four options for print devices: LPT1, LPT2, COM1, and COM2.

The different options may be viewed by pressing the space bar; once the desired Default Print Device is shown, simply press [ENTER] to accept the device and return to the Main Menu.

The two system default modes set values for the constants used to calculate landfill gas generation rates: k and Lo. The regulatory system default mode is the default selection. The two modes have the following values:

Regulatory (the default selection):	
k (methane decay rate constant):	0.05 1/yr
Lo (methane generation rate constant):	6000 ft^3 methane/Mg of refuse
NMOC concentration (for hexane):	4000 ppmv
AP-42:	
k (methane decay rate constant):	0.04 1/yr
Lo (methane generation rate constant):	4411 ft^3 methane/Mg of refuse
NMOC concentration (as hexane):	2420 ppmv for codisposal
	595 ppmv for no codisposal

The program can calculate emissions for up to 200 years past landfill closure, as long as the total number of years the landfill was in operation and the number of years past closure for which the program will calculate emissions do not exceed 300.

5.7 Calculate Air Emissions

Selecting Calculate Air Emissions from the Main Menu causes the program to calculate the air emissions. While the calculations are taking place, the Calculation in Progress screen shown in Figure 35 will appear. After the calculations are complete a Calculation Summary will appear, summarizing the emissions in the current year and the emissions in the year when they will be the highest (the maximum year); an example Calculation Summary is shown in Figure 36. Pressing any key will cause the Main Menu to reappear.

5.8 Display Results

Selecting Display Results from the Main Menu will cause the Display Results menu shown to Figure 37 to appear, which gives the user the option of presenting the data in a Tabular Report or On-Screen Graphic format. If the On-Screen Graphic option is selected and a Hercules Graphics Card is being used then MSHERC must be activated prior to running the program. This is done by typing MSHERC while in the subdirectory containing the program and pressing [ENTER]. Once the On-Screen Graphic option is selected, the screen shown in Figure 38 will allow the user to select a chemical to view in graphic form. An example graphics display is presented in Figure 39. The on-screen graphics display may be dumped to a dot matrix printer for a hard copy, if the GRAPHICS.COM utility was loaded prior to running the program. Also, the

Calculation in Progress
Current Year 2103

Figure 35. Calculation in Progress screen

Calculation Summary	
Current Year Results : 1990	Maximum Year Results : 1992
Methane : 3.651E+002 Mg/yr 1.933E+007 Cft/yr	Methane : 4.115E+002 Mg/yr 2.178E+007 Cft/yr
Carbon Dioxide : 1.002E+003 Mg/yr 1.933E+007 Cft/yr	Carbon Dioxide : 1.129E+003 Mg/yr 2.178E+007 Cft/yr
NMOC : 3.139E+001 Mg/yr 3.092E+005 Cft/yr	NMOC : 3.538E+001 Mg/yr 3.486E+005 Cft/yr

Figure 36. Calculation Summary

tabular report file can be imported into Lotus 1-2-3 by using the file import function (/FIN). Some of the data at the top of the spreadsheet will appear muddled; however, the tables of data used to generate the graphical analysis will remain applicable, and can be used to generate Lotus graphs.

If the Tabular Report option is chosen, then the Tabular Report sub-menu shown in Figure 40 will appear. This sub-menu gives the user the option of sending the report to the screen, printer, or to a file. If the Output to File option is chosen, the entry form shown in Figure 41 will appear. This entry form lets the user enter the filename under which the report is to be written. The file will be written to the current working directory; the current working directory can be viewed or changed by selecting the Configure Program option from the Main Menu. Once an option chosen, as described before, the Choose a Chemical to Report screen (Figure 38) will appear so that a chemical for reporting can be chosen. After a selection has been made, the report will be displayed on the screen, printed by the printer, or written to a file. An example report is shown in Figure 42.

5.9 Printing Results

After calculating the air emissions, a report can be generated by selecting the Display Results command. A dialog box will open and offer the choice of a Tabular Report or an On-Screen Graphic. After making a selection, you must also choose the pollutant you wish to have displayed. In the case of a Tabular Report, you will be asked to specify output to screen, output to printer, or output to file. Before choosing one of these options, be sure that the program is properly configured (see section 5.6).

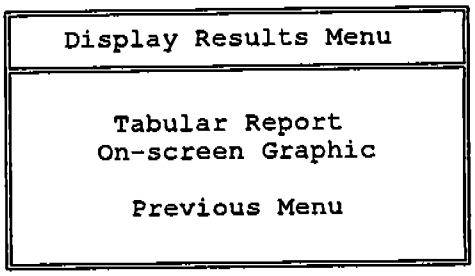


Figure 37. Display Results sub-menu

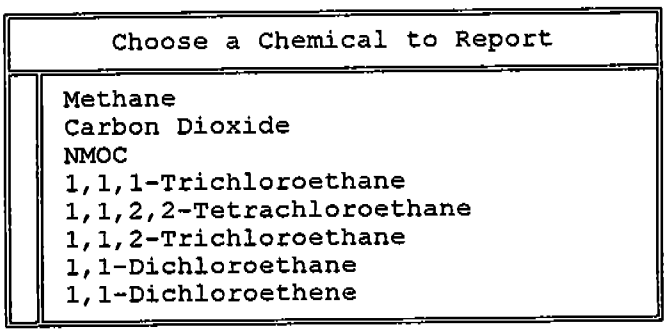


Figure 38. Choose a Chemical to Report screen

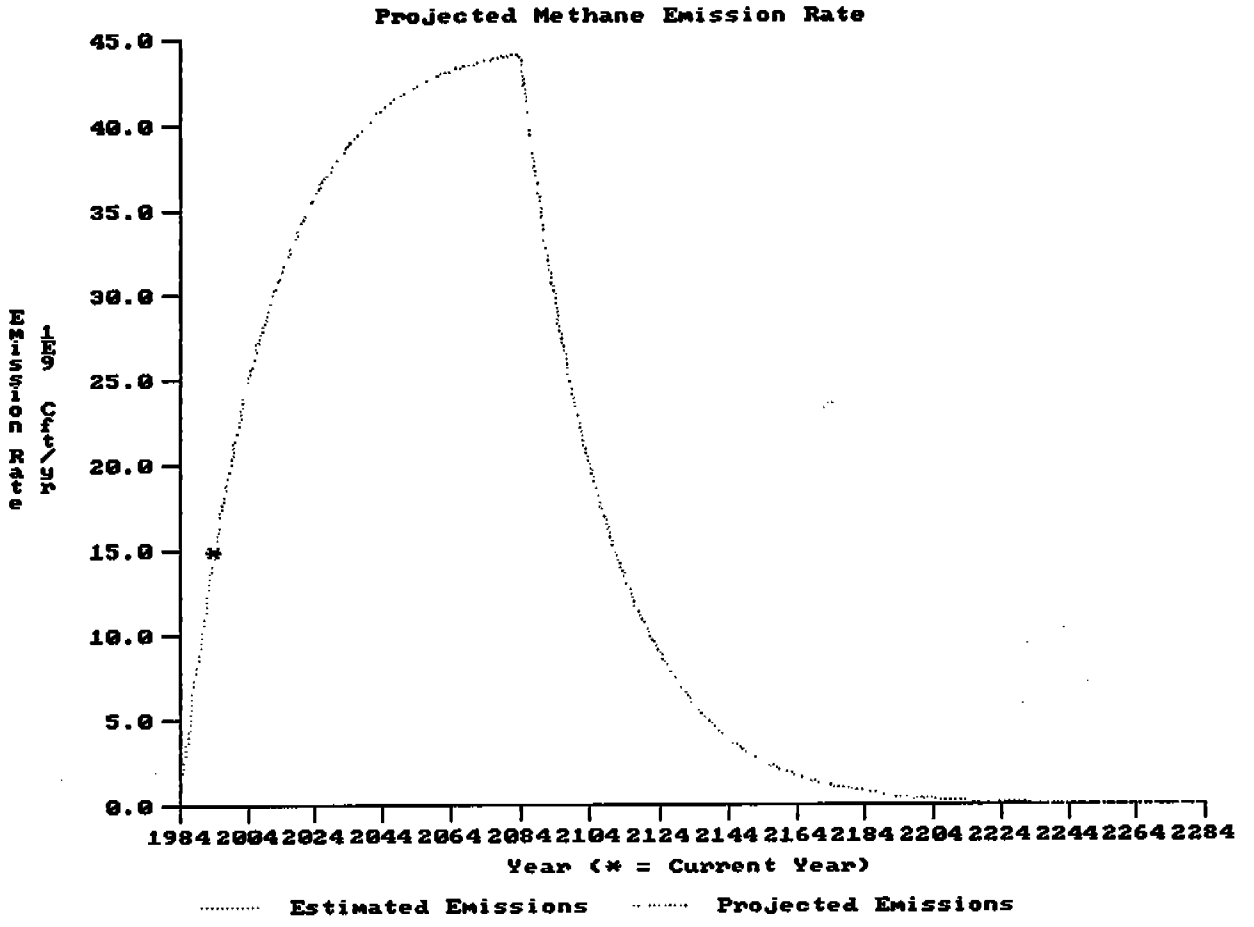


Figure 39. Example graphics display

652-015-59-02\Landfil3\tom
3-12-96

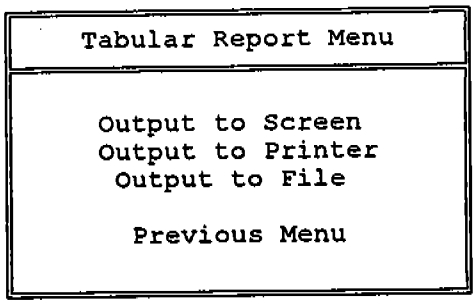


Figure 40. Tabular Report Menu

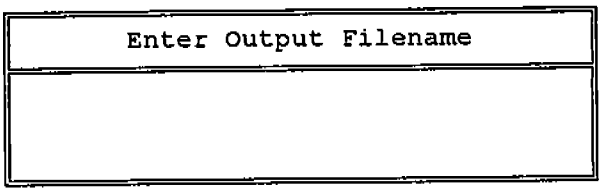


Figure 41. Enter Output Filename screen

View Model Results

Model Parameters

Lo : 6000.000000 Cft / Mg
k : 0.050000 1/yr

NMOC : 4000.000000 ppmv
Methane : 50.000000 % volume
Carbon Dioxide : 50.000000 % volume

Landfill Parameters

Year Opened : 1980 Current Year : 1990 Year Closed : 1992
Capacity : 150000.000000 Mg
Average Acceptance Rate : 13000.000000 Mg/year
Average Acceptance Rate Required from
Current Year to Closure Year : 10000.000000 Mg/year

Figure 42. Example model results output

5.10 Exiting

Select Exit to exit the program. Before exiting, the user will be asked if the current study is to be saved. This screen is shown in Figure 44.

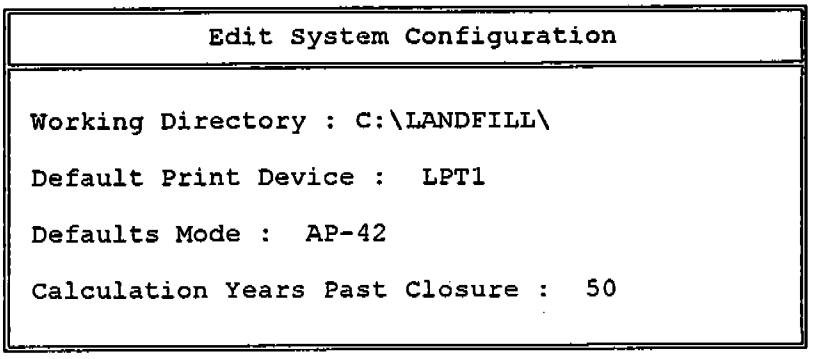


Figure 43. Edit System Configuration screen

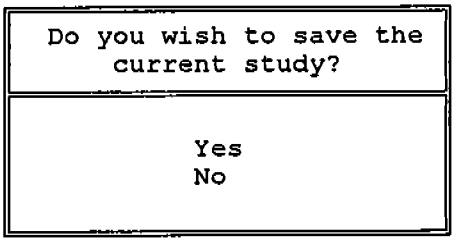


Figure 44. Save study menu

6.0 REFERENCES

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APPENDIX A

Example User Session for the Windows Model

APPENDIX A

EXAMPLE USER SESSION FOR THE WINDOWS MODEL

LANDFILL SCENARIO:

Design Landfill Capacity:	3,000,000 Mg
Annual Refuse Acceptance Rate:	109,890 ton/yr from 1980 to 1994
Year Opened:	1975
Refuse in Place in 1980:	330,500 tons

Open a New Landfill Study Document

1. In the Windows Program Manager, open the File Manager. If you copied the program files to the c:\Landfill directory, select the C: drive. Select the Landfill directory. Select landwin.exe.

2. The landfill air emission estimation model will open with an abbreviated menu. At this opening menu, select File.

3. Select New to open a new study. A landfill study window (the Operating Parameters window) will open. The landfill study is identified as landfill.000. This name will be replaced by a user-supplied name when the landfill study is saved and named.

Enter Year Opened and Design Capacity

1. Select the year opened text box in the data entry box. The year opened defaults to 10 years before the current year (determined from the computer's clock).

2. Delete the default year opened. Type in 1975.

3. Select the Capacity text box and type in 3.0E+06 for 3,000,000 Mg refuse capacity. Press [Enter] to accept this value.

Convert Units of Refuse in Place and Refuse Acceptance Rate

1. Because the refuse in place in 1980 and annual refuse acceptance rate values for this landfill are recorded in tons and the program calls for megagrams, the units of measure need to be converted.

2. From the Main Menu, select Utilities.

3. Select Unit Conversions to bring up the dialog box for the unit conversion utility.

4. Select the "To convert from" text box. Type in the refuse in place value, including the units: *330,500 tons.*

5. Select the "to" text box. Type in the units to which you want to convert: *Mg.*

6. Press [Convert].

7. The box with the result (the "multiply quantity in source unit by" text box) will give the value of the refuse in place in Mg. This value rounds to 300,000 Mg. Record this value to use later.

8. To convert the annual acceptance rate to Mg, select the "To convert from" text box. Delete the value in it and type in *109,890 tons.*

9. Select the "to" box and type in *Mg.*

10. Press [Convert]. The annual acceptance rate in Mg rounds to 100,000 Mg. Record this value to use later.

11. To exit the unit conversion utility, press [Cancel] or double-click on the close box in the upper left corner of the conversion utility dialog box.

Enter Refuse in Place for the First Year of Accepting Refuse

1. In the Operating Parameters table, select the year 1980. The cells in the Acceptance Rate/Refuse in Place column for 1980 will be highlighted by a bold box around them.

2. Select the button in the data entry box for Refuse in Place.

3. Select the Waste Value text box.

4. Type in 3.0E+05 (300,000) for the refuse in place in 1980. Press [Enter] to accept the value. The program will enter 3.0E+04 as the refuse in place for all following

years up to the current year until you enter specific values for specific years. The table represents refuse in place, which is cumulative.

Enter Refuse Acceptance Rates for Following Years

1. Refuse in place values in this model are calculated at the beginning of the year. That is, the refuse in place for a landfill is a total of the previous year's refuse in place and the previous year's refuse acceptance rate. If the refuse acceptance rate for 1980 is 100,000 Mg and the refuse in place for 1980 is 300,000, then the 1981 refuse in place value will be 400,000 Mg.

2. To enter amounts of refuse into the landfill study by how much refuse is accepted in a year, leave the 1980 row selected on the Operating Parameters table, or select it, either with the mouse or the cursor motion keys.

3. Select the 1980 row in the Operating Parameters table. Select the Acceptance Rate (Mg/yr) button in the data entry box.

4. Select the Waste Value box. Enter 1.0E+05 (100,000) for the acceptance rate for 1980. Press [Enter] to accept this rate. The 1981 value for Refuse in Place will be 400,000 Mg. The 1980 value of Refuse in Place will remain the same.

5. Enter 100,000 as the refuse acceptance rate for the years 1981-1993. To do this, select the 1981 text box. Select the Waste Value text box in the data entry box. Enter 1.0E+05 (100,000). Press [Enter] to accept this rate. The 1982 refuse in place value will be 500,000. Repeat for the years up to 1993. With an acceptance rate of 100,000 Mg of refuse per year for the landfill for the years 1980-1993, the refuse in place for 1994 should be 1,700,000 Mg.

Set Model Options

1. Select File from the Main Menu. Select Options. A Set Model Options dialog box will come up.

2. Select the Calculate Years Past Closure text box.

3. Delete the default value.

4. Enter 50 to have the program calculate emissions from 50 years past the landfill closure date.

5. Select [Save] to save this value.

6. A default closure year for the landfill will be calculated by the program. The program will average the acceptance rates of the data entered in the Operating Parameters table, and apply that acceptance rate to the years following the current year to calculate when the refuse in place in the landfill will reach the design capacity. The closure year for the landfill can also be specified by the user.

7. To set the closure year of the landfill, select Parameters.

8. Select Closure Year ... A Closure Year dialog box will come up. Select User Specified if you want to specify the closure year.

9. Type in *2007*. Select [OK]. The program will estimate the acceptance rate for the years the landfill is open that will result in the landfill reaching design capacity by the closure year specified by the user.

Set Model Default Values

1. To set the default values for k and Lo used to calculate emissions, select Defaults from the Main Menu.

2. To set the system for estimating emissions to comply with Clean Air Act (CAA) regulations for municipal solid waste landfills, select CAA.

3. Select Parameters from the Main Menu.

4. Select Landfill type.

5. Select Codisposal. This option should be used when the landfill has been used to dispose of hazardous waste.

Set Pollutant Concentrations

1. Select Parameters from the Main menu.

2. Select Air Pollutants. An Air Pollutants Parameters dialog box will appear.

3. Methane and carbon dioxide are assumed to make up 50 percent each of the landfill gas. Leave these percentages as they are.

4. The NMOC concentration is set by the CAA defaults, so the other options, AP-42 defaults and User Specified defaults, are dimmed and cannot be selected.

5. A total of 46 toxic air pollutants expected to be emitted from landfills are included in the program. Additional toxic air pollutants can be added or inappropriate ones

can be deleted. To edit the list of toxic air pollutants for which emissions will be estimated, select the [Edit Air Pollutants] button. A Selected Air Pollutants dialog box will open.

6. To add an additional entry for ethyl mercaptan, select [Append]. Entry 47 of 47 will appear.

7. Select the name text box. Delete the information in the box and type in *ethyl mercaptan.*

8. Select the molecular weight text box. Delete the information in the box and type in *62.13.*

9. Select the concentration, codisposal, text box. Delete the information in the box and type in *0.86.*

10. Select the concentration, no codisposal, text box. Delete the information in the box and type in *0.86.*

11. Select [OK] to accept these data and add ethyl mercaptan to the list of toxic air pollutants for which emissions will be estimated. In the Air Pollutants Parameters dialog box, select [OK] to accept the set values for pollutant concentrations.

Generate a Textual Report of Emissions

1. To see the emissions generated based on the operating parameters, program defaults, and pollutant concentrations selected, select Reports from the Main Menu. To generate a textual report of emissions, select Text ... A Select an Emitted Substance dialog box will appear.

2. Select Benzene as the pollutant to report. Select [OK] to generate the emission report for all the years the landfill is open, plus the number of years past closure you specified. A report will appear in the landfill study window.

3. To print the report, select File from the Main Menu. Select Print. A Print a Graph dialog box will come up, with a list of available printers.

4. Select a printer. Select [Print].

Generate a Graphical Report of Emissions

1. To generate a graphical report of emissions, select Reports from the Main Menu. Select Graphics...

2. Select Benzene. Select [OK].

3. Select File from the Main Menu.

4. Select Print from the File menu. Select [Print].

Save the Landfill Study

1. To save the landfill study and assign a filename, select File from the Main Menu. Select Save As. A dialog box for Save As Landfill Study will appear, with a list of the landfill study files, if there are any (landfill study files are assigned a .PRM file extension), in the working directory for the program. The landfill study will be filed in the working directory of the program unless you specify another directory.

2. Select the File Name text box. Type *test*. The program will add the .PRM extension to the filename. This study will be saved in the working directory for the program as Test.PRM. Select [OK].

Exit the Program

1. Select File from the Main Menu.

2. Select Exit.

APPENDIX B

Example User Session for the DOS Model

APPENDIX B

EXAMPLE USER SESSION FOR THE DOS MODEL

LANDFILL SCENARIO

Landfill Design Capacity:	3,000,000 Mg
Annual Acceptance Rate:	100,000 Mg/yr from 1980 to 1994
Year Open:	1975
Refuse in place in 1980:	300,000 Mg

STEPS

Specify Study

1. At the Main Menu select the Specify Study option.

2. Select New Study.

3. Enter "test" for the study name for this example.

Configure Program

1. Select the Configure Program option.

2. Select a Default mode: Regulatory or AP-42. Select Regulatory.

3. Select a number of years past closure for which the program will estimate emissions. Select 50.

Edit Study Data

1. Select the Edit Study Data option from the Main Menu.

2. Select Chemical Composition from the Edit Study Data sub-menu.

3. Since site-specific data on methane (CH_4), carbon dioxide (CO_2), NMOC, and toxic air pollutants concentrations are not specified for this example landfill, accept the suggested default chemical compositions provided by pressing [F10].

4. Accept the suggested default air pollutant concentrations provided by pressing [F10]. (For this example it is assumed that Method 18 testing has not been done.)

5. Select the Methane Rate Constant (k) option from the Edit Study Data sub-menu.

6. Because site-specific testing was not performed for this example landfill, select the Use Default Value of k (0.05 1/yr).

7. Select the Methane Potential (Lo) option.

8. Accept the suggested default for Methane Generation Capacity (6000 ft^3/Mg) by pressing [F10].

9. Select the Operational Data option from the Edit Study Data sub-menu.

10. Enter 1975 as the year open. Press [ENTER].

11. Enter 1994 as the current year. Press [ENTER].

12. Enter the design capacity of 3,000,000 Mg. Press [ENTER].

13. Enter 300,000 Mg of refuse in place for 1980. Press [ENTER]. Add 100,000 Mg each year until 1994. For this example: the refuse in place for 1994 will be 1,700,000 Mg.

14. Accept these data by pressing [F10].

15. The expected year of closure should be 2007 assuming an acceptance rate of 118,182 Mg/year from the current year to closing year.

16. Accept the generated year of closure and refuse acceptance rate by pressing [F10]. For this example it is assumed that the year of closure calculated was acceptable.

17. Select the Previous Menu option from the Edit Study Data sub-menu to return to the Main Menu.

Calculate Air Emissions

1. Select the Calculate Air Emissions option.

2. A calculation summary with the following results should appear:

Current Year Results: 1994	Maximum Year Results: 2005
Methane	Methane
6.616E+003 Mg/yr	9.008E+003 Mg/yr
3.502E+008 Cft/yr	4.768E+008 Cft/yr
Carbon Dioxide	Carbon Dioxide
1.815E+004 Mg/yr	2.472E+004 Mg/yr
3.502E+008 Cft/yr	4.768E+008 Cft/yr
NMOC	NMOC
2.844E+002 Mg/yr	3.872E+002 Mg/yr
2.802E+006 Cft/yr	3.815E+006 Cft/yr

3. Press any key to return to the Main Menu.

Display Results

1. Select the Display Results option. Press [ENTER].

2. Select the Tabular Report option. Press [ENTER].

3. Select the Output to Screen option. Press [ENTER].

4. Select Benzene as the chemical to report.

5. A detailed report of benzene emissions for the study results may then be reviewed on the computer screen. For benzene, the emissions in the year 2005, the year of closure, should be 3.147×10^{-2} Mg/yr or 3.421×10^{2} cubic ft/yr.

6. Return to the Tabular Report Menu by pressing [ESC].

7. Return to the Display Results Menu by pressing [ESC].

8. Return to the Main Menu by pressing [ESC].

Configure Program

1. Select the Configure Program option.

2. The working directory will be the directory in which the study will be saved. If your working directory is C:\LANDFILL\, the study will be saved to C:\LANDFILL.

3. Select the print device, the defaults, and the years past closure for which you want emissions calculated (the default is 50) and return to the Main Menu by pressing [F10].

Exit

1. Select the Exit option to exit the program.

2. Select yes to save the current study.

3. The study has been saved and you should be returned to the DOS prompt.

4. If the study needs to be used again, then simply go into the program and select the Old Study option under the Specify Study Type sub-menu.

5. Now enter "test."

6. Study name "test" is now enabled and can be revised or accessed to make new reports.

APPENDIX C

How to Download the Landfill Air Emissions Estimation Model from the Control Technology Center (CTC) Bulletin Board

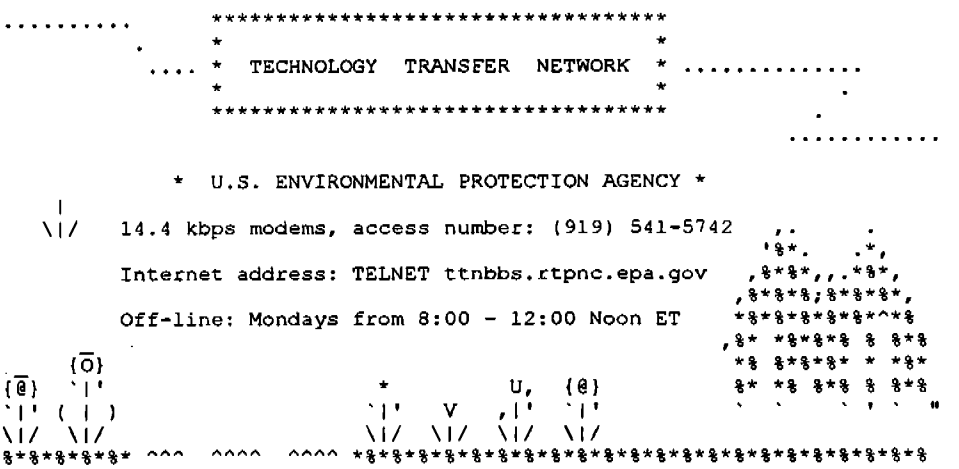
Obtaining the Landfill Air Emissions Estimation Model Via the EPA Technology Transfer Network Bulletin Board System (TTN-BBS)

The EPA established the TTN-BBS as a mechanism to distribute up-to-date information regarding regulatory issues as well as a host of tools to use in assessing and managing environmental data. The CTC has placed the Landfill Air Emissions Estimation Model in their portion of the TTN-BBS to permit public access to the system at no cost. Therefore, obtaining the model via the TTN-BBS provides an effective method for obtaining the most current version in a cost effective manner.

To obtain the model, you will need a modem and terminal emulator package which supports binary downloads. The TTN-BBS supports modems through 14400 baud.

You can reach the TTN-BBS at (919) 541-5742. The serial connection parameters are 8 bits, 1 stop bit, and no parity.

Once you have connected, you will see the following opening screen:



The TTN-BBS system is an open BBS system which allows individuals to register as users online and obtain immediate access to all parts of the system. As a new user, you will be asked to submit your first and last name, city, state, and a password for use in future logins. Once this information is submitted, you will also be required to register as a user by entering additional information such as your mailing address and phone.

Once registered, you have full access to the information on the TTN-BBS. Initially, bulletin information is displayed. Once you have signalled to continue, you will be presented with the following screen:

```
+------------------------------------------------------------------------------+
| * 03/08/96 *       TECHNOLOGY TRANSFER NETWORK TOP MENU          * 10:34 *  |
+------------------------------------------------------------------------------+

        +-----------------------------------------------------------+
        |                  <U> User Support/Help                    |
        |                  <X> BBS Descriptions                     |
        |-----------------------------------------------------------|
        |    <T> GATEWAY TO TTN TECHNICAL AREAS (Bulletin Boards)   |
        |-----------------------------------------------------------|
        |                  <1> System Utilities                     |
        |                  <2> Email (Private)                      |
        |                  <3> TTN Bulletins                        |
        |                  <4> Leave SYSOP(s) a Message             |
        |                  <5> Read Cubbyhole (Stored) Messages     |
        |                  <6> TTN Policies                         |
        |                  <7> TTN Open Forum (Public)              |
        |-----------------------------------------------------------|
        |                  <G> Goodbye  (Exit The TTN)              |
        +-----------------------------------------------------------+

Command:
```

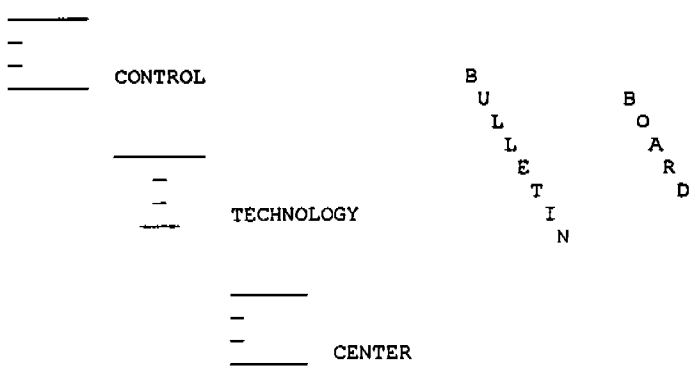
Enter the TTN Technical Areas of the system by entering 'T' at the command prompt. The system will display a screen with the following available technical area selection:

```
+------------------------------------------------------------------------------+
|                        TTN TECHNICAL INFORMATION AREAS                       |
+------------------------------------------------------------------------------+
  <J>  AIRS   - Aerometric Information Retrieval Systems Information
  <I>  AMTIC  - Ambient Monitoring Technology Information
  <F>  APTI   - Air Pollution Training Institute
  <E>  CAAA   - Clean Air Act (Rules/Policy/Guidance)
  <T>  CarD   - Greenhouse Gas Car Dialogue
  <D>  CHIEF  - Emission Inventories/Emission Factors Information
  <L>  COMPLI - COMPLIance Information on Stationary Sources of Air Pollution
  <H>  CTC    - Control Technology Information
  <B>  EMTIC  - Emission Measurement Technical Information
  <N>  NATICH - National Air Toxics Information
  <A>  NELAC  - National Environmental Laboratory Accreditation Committee
  <O>  NSR    - New Source Review Information
  <M>  OMS    - Mobile Sources Information
  <U>  ORIA   - Radiation and Indoor Air Information
  <W>  OTAG   - Ozone Transport Assessment Group
  <K>  RBLC   - RACT/BACT/LAER Clearinghouse (Formerly BLIS)
  <C>  SCRAM  - Regulatory Air Models/Information
  <Q>  SBAP   - Small Business Assistance Program Information
  <R>  GEI    - Geographic/Ecosystems Initiatives
  <G> Goodbye   <-> Return to TTN TOP Menu

Command:
```

Enter 'H' at the command prompt to enter the CTC portion of the BBS. The following greeting will be displayed:

```
Type P to Pause, S to Stop listing




*** Any Key for More, <S> to Stop ***
```

After continuing, you will be asked to indicate your user class via the following screen:

```
WELCOME TO THE CONTROL TECHNOLOGY CENTER BULLETIN BOARD

    Help us keep track of the number of users
    by telling us about yourself.  Are you from:

         (1) A Local or Regional Agency

         (2) A State Agency

         (3) A Federal Agency

         (4) A Private Company

         (5) The C T C Staff

    Please Enter a Number (1 - 5) ===>
```

Once this is entered and the bulletin information is displayed, you will see the following menu:

```
+-------------------------------------------------------------------------+
|        C T C  BBS ==== MAIN MENU      SYSOP - Joe Steigerwald (919) 541-2736 |
+-------------------------------------------------------------------------+
        +-----------------------------------------------------------+
        |  **   C T C UTILITIES    **  |  ** DOCUMENTS / SOFTWARE  **  |
        |                              |                               |
        |  <W>elcome to the CTC        |  <O>rdering Documents         |
        |  <R>ead CTC Alerts           |  <D>ownloading CTC Software   |
        |  <C> Register for CTC Mail   |       and Other Items         |
        |  <-> Return to Top Menu      |  <S> Review Document Summary  |
        |  <G>oodbye                   |                               |
        |------------------------------|-------------------------------|
        |  **   C T C PROJECTS     **  |  **      HELP CENTER        **  |
        |                              |                               |
        |  <L>ist CTC Ongoing Projects |  <P> CTC Public Messages      |
        |  <A>dd to List of Suggested  |  <E> TTN Email (Private)      |
        |       Projects               |  <B> Leave CTC HOTLINE        |
        |                              |         Request               |
        +-----------------------------------------------------------+

Command:
```

To download the program and other information, enter 'D' at the command prompt. A directory of available files will be displayed. Locate the file you want from the directory listing. After the listing is finished, the following command prompt will be displayed:

```
<D>ownload, <P>rotocol, <E>xamine, <N>ew, <S>earch, <L>ist, or <H>elp
Selection or <CR> to exit:
```

Signal your desire to download the file by entering 'D.' Enter the filename at the name prompt and select the appropriate transmission protocol. The BBS system will begin sending the file. In some terminal software packages, you will need to initiate the receiving process.

The files transmitted via the TTN-BBS are typically compressed via the PKZIP® program. You may need to also obtain this program from the TTN-BBS system (instructions for doing this are displayed at the beginning of the download listing) or other source.